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NORTH AMERICAN STIPEAE (GRAMINEAE): TAXONOMIC CHANGES AND OTHER COMMENTS¹

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ABSTRACT

The generic treatment of North American Stipeae is substantially modified. Seven genera are recognized, *Achnatherum*, *Piptatherum*, *Oryzopsis*, *Ptilagrostis*, *Piptochaetium*, *Nassella*, and *Hesperostipa*. Only *Hesperostipa* has not previously been recognized at the generic level. The characteristics of each genus are summarized and the 45 new combinations necessitated by this treatment presented. All species occurring in the continental U.S.A. and Canada are treated, plus a few of those occurring in northern México. The largest genus, both globally and regionally, is *Achnatherum*. *Hesperostipa* comprises four species, *H. comata*, *H. spartea*, *H. curtiseta*, and *H. neomexicana*. The taxonomic changes at the specific level are 1) the description of a new species, *A. perplexum*, 2) modification of the limits of *A. lobatum*, *A. occidentale*, and *A. coronatum*, and 3) selection of a neotype for *Stipa robusta* (Vasey) Scribner.

KEY WORDS: Gramineae, Stipeae, Taxonomy, Nomenclature, North America

The Stipeae is a cosmopolitan tribe comprising approximately 500 species. The limits of the tribe are now well accepted. Its members have a single floret per spikelet, with no rachilla extension, glumes that usually extend beyond the lemma apex, a well developed callus, a lemma that is usually stiff or hard, and a terminal, usually articulated awn. Anatomically, the tribe seems to be united by having a 95-130° angle between the coleorhiza and coleoptile (Reeder

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1957; Matthei 1965; Barkworth 1982), but this character has been examined in relatively few species.

The generic interpretation of the Stipeae in most North American floras is based on A.S. Hitchcock's (1935, 1951) treatments which recognize three genera in North America, *Stipa*, *Oryzopsis*, and *Piptochaetium*. Some modifications of these genera have been proposed (e.g., Parodi 1944; Johnson 1945a; Spellenberg & Mehlenbacher 1971) but the widespread adoption of Hitchcock's generic treatment has limited their adoption. This paper presents the combinations used to treat the North American Stipeae in the forthcoming *Jepson Manual* and *Manual of North American Grasses*. I have included a key to the genera and generic descriptions, and listed the species within each genus that occur in the continental U.S.A. and Canada. Where changes in species delimitation are proposed, the reasons for the change are summarized following the appropriate name.

The discrepancy between traditional treatments of the Stipeae and the phylogenetic history of the tribe was first convincingly demonstrated by Parodi (1944). He showed that species sharing a number of highly unusual leaf and floret characteristics were being placed in two different genera, *Stipa* and *Piptochaetium*, because traditional treatments emphasized ecologically adaptive features of the floret, callus, and awn. As a result of his studies, Parodi (1944) transferred several species from *Stipa* to *Piptochaetium*, including two species that occur in the U.S.A., *P. avenaceum* and *P. pringlei*.

Thomasson (1976, 1978, 1979) provided additional evidence supporting Parodi's expansion of *Piptochaetium* and recommended the expansion of *Nassella* to include several species then included in *Stipa*, but made no formal nomenclatural proposals. Thomasson also stated that, even with the nasseloid species of *Stipa* excluded, *Stipa* as interpreted in North America included representatives of two different lineages. My studies (Barkworth 1981, 1982, 1983, 1990; Barkworth & Everett 1987) corroborated and extended Thomasson's conclusions. Barkworth (1990) revised the limits of *Nassella* and outlined the "major groups" of American Stipeae. In this paper, I formalize the treatment of these groups for the U.S.A. and Canada, and include the names of one Mexican species examined by Hoge (1992). For each new combination or name, only the basionym and the synonyms in current use are shown. A more complete listing of synonymy can be found in A.S. Hitchcock (1951). Making the changes needed for the 150-200 American species occurring south of the Mexican-U.S.A. border was beyond the scope of this study. I encourage others to pursue the task.

KEY TO THE GENERA OF NORTH AMERICAN STIPEAE

1. Palea longitudinally grooved and longer than the lemma, protruding from

between the lemma margins at the lemma apex; lemma margins involute, fitting into the paleal groove. *Piptochaetium*

1. Palea flat, shorter than or equaling the lemma, usually not protruding at the lemma apex (awnlike tips of the veins protruding in *A. stillmanii*); lemma margins flat.
 2. Lemma margins strongly overlapping; palea less than one third the length of the lemma, glabrous and ecostate. *Nassella*
 2. Lemma margins not or only slightly overlapping; palea from one third the length of the lemma to equaling it, usually pubescent (always pubescent if short), 2 veined.
 3. Palea usually pubescent and shorter than or equal to the lemma, its apex flat; palea veins usually terminating below the apex; lemma usually coriaceous but not indurate.
 4. Leaf blades filiform, less than 0.5 mm wide; plants tightly cespitose, occupying damp to boggy subalpine and alpine habitats. *Ptilagrostis*
 4. Leaf blades not filiform, usually more than 0.5 mm wide; plants of various habitats, from mesic to seasonally dry and sea level to subalpine. *Achnatherum*
 3. Palea often glabrous, always as long as the lemma, its apex appearing prow tipped or "pinched"; veins terminating at the apex; lemma indurate.
 5. Florets more than 7.5 mm long; callus sharp. *Hesperostipa*
 5. Florets less than 7.5 mm long; callus blunt.
 6. Florets dorsally compressed; lemma margins not overlapping, the palea exposed, at least in part. *Piptatherum*
 6. Florets terete or laterally compressed; lemma margins often overlapping, concealing the palea. *Oryzopsis*

NOTE: New names or combinations are presented in bold face; existing names are italicized and presented only to clarify the limits of each genus in North America.

ACHNATHERUM P. Beauvois

Plants tufted, sometimes with short rhizomes. Culms erect, not branching. Ligules membranous, sometimes ciliate, the hairs sometimes exceeding the membranous portion; collar sometimes ciliate; blades conduplicate, involute, or convolute. Panicle usually contracted, varying to open. Glumes

longer than the floret, usually tapering from midlength or below, with 1, 3 or 5 evident veins, the apex acute to acuminate; floret terete, usually ellipsoidal to cylindrical, sometimes globose; callus 0.2-2 mm long, blunt or sharp, usually strigose above; lemma stiffly membranous to coriaceous, rarely indurate, usually pubescent, the hairs usually evenly distributed, sometimes conspicuous; lemma apex generally with membranous lobes 0.5-2 mm long, these occasionally thick or awnlike; awn 3-80 mm, usually scabrous to scabridulous, sometimes pilose in whole or in part, if more than 1 cm long, persistent, twisted below and once or twice geniculate, if less than 1 cm, readily deciduous, scarcely twisted and nongeniculate; palea from 1/3 the length of the lemma to equaling it, pubescent (ours) or glabrous, similar in texture to the lemma, 2 veined, the veins usually terminating before the rounded apex (veins extended in *A. stillmanii*). LECTOTYPE (Niles & Chase 1925): *Achnatherum calamagrostis* (L.) P. Beauvois. Name from the Greek, *achne*, scale, and *ather*, awn, a reference to the awned lemma.

A.S. Hitchcock (1925, 1935, 1951) included the short awned species of *Achnatherum* in *Oryzopsis* and the long awned species in *Stipa*. The treatment of *Achnatherum* adopted here is broader than that adopted by Tzvelev (1976) and Tutin (1980) but consistent with the interpretation of Keng (cited in Tzvelev 1977), Tzvelev (1977), and Lu & Kuo (1987). It is also supported by lemma epidermal pattern (Thomasson 1976, 1978, 1979; Barkworth & Everett 1987) and epiblast morphology (Matthei 1965; Barkworth 1982, 1990), to the extent that these characteristics have been investigated. The association of short, rounded florets with short, deciduous awns, characters that would place a species in *Oryzopsis* sensu Hitchcock (1935, 1951; Johnson 1945a), is a consequence of selection for endozochoric dispersal (Parodi 1944) by consumption.

Under the interpretation presented here, *Achnatherum* becomes the largest and most widespread genus in the Stipeae. It occurs in Australia, Eurasia, Africa, New Zealand, and South America as well as North America, although it has not yet been recognized nomenclaturally in Australasian, African, and South American floras. In the Americas and Eurasia, its members appear to be associated with montane regions. It is unclear whether the North American species are descended from South American or Eurasian ancestors, or both. I consider that *Achnatherum* is more closely related to *Piptatherum*, *Ptilagrostis*, and *Stipa* sensu stricto (Barkworth 1990) but Thomasson (1976, 1979, 1989 in litt.) argued that its closest relative is *Nassella*.

Most North American species of *Achnatherum* are, morphologically, rather uniform and resemble species found in Eurasia and other parts of the Americas. A few species, formerly included in *Oryzopsis*, are distinctive in having shorter florets and readily deciduous, short awns. There is at least one distinctive subgroup among the South American taxa that is not represented in the U.S.A. or Canada. Members of this subgroup have strongly tapering

florets, a glabrous, stiff palea and a lemma with long, divergent apical hairs. One representative, *A. papposum*, has been collected in California. Formal recognition of such infrageneric groups would, however, be premature without a comprehensive study of the genus.

Achnatherum stillmanii is anomalous among North American species of *Achnatherum* because it is rhizomatous, averages over 1.5 m in height, has awnlike lobes at the lemma apex, paleas with veins that extend as awnlike tips above the top of the lemma, and because of its lemma epidermal pattern. It appears to be more closely related to sect. *Aristella* (Trinius) Tzvelev [= *Stipa* sect. *Achnatheropsis* Tzvelev], which includes *A. bromoides* (L.) P. Beauvois, than to sect. *Protostipa* Tzvelev, to which most of our species belong.

The most difficult aspect in circumscribing *Achnatherum* is determining how to treat the Australian taxa, all of which are now included in *Stipa*. If included in *Achnatherum*, the range of variation within the genus would have to be expanded to include, for instance, branched culms and a sulcate palea, but it would still be a smaller and more uniform genus than *Stipa* sensu Hitchcock (1951).

Acceptance of *Achnatherum* is not universal. Clayton & Renvoize (1986) included it in *Stipa* without comment. Freitag (1985) adopted a broader concept of *Stipa* than Clayton & Renvoize (1986), based on species that he considered morphologically intermediate between *Achnatherum*, *Stipa*, *Trikeria*, and *Ptilagrostis*. These taxa are part of the same evolutionary line within the tribe, but micromorphological, anatomical, and cytological data suggest that *Stipa* should either be expanded to include several North American species currently placed in *Oryzopsis*, an option not discussed by Freitag (1985) or Clayton & Renvoize (1986), or split into a number of more uniform segregate genera, the alternative I prefer.

Achnatherum altum (Swallen) Hoge & Barkworth, *comb. nov.* BASIONYM: *Stipa alta* Swallen; Proc. Biol. Soc. Wash. 56:79 (1943). TYPE: US 2209361!; MEXICO. Coahuila: Sierra de la Madera, Municipio Cienegas, Cañon del Agua; 10 September 1939; C.H. Muller 3261.

Achnatherum altum is sometimes included in *A. lobatum*, but has longer ligules (0.9-5.2 mm vs. 0.3-0.9 mm) and shorter lemma lobes (0.2-0.7 mm vs. [0.4]0.6-1.2 mm). Marshall Johnston, in his Flora of the Chihuahuan Desert (unpubl.) comments that plants referable to *A. altum* [as *Stipa alta*] intergrade with typical members of *A. lobatum*. Hoge (1992) examined specimens referable to these and five other taxa during her study of *A. perplexum*. Although there was overlap in individual characters, the two taxa are distinct, based on an assessment of overall morphological similarity using Gower's distance measure and enzyme similarities (Hoge 1992). *Achnatherum altum* is restricted to México.

Achnatherum aridum (M.E. Jones) Barkworth, *comb. nov.* BASIONYM: *Stipa arida* M.E. Jones, Proc. Calif. Acad. Sci., Ser. 2, 5:725 (1895). TYPE: UNITED STATES. Utah: Marysvale; M.E. Jones 5377.

Achnatherum brachychaetum (Godron) Barkworth, *comb. nov.* BASIONYM: *Stipa brachychaeta* Godron, Mém. Sect. Sci. Acad. Sci. Montpelier 1:450 (1853).

This species, which is listed by the federal government in the U.S.A. as a noxious weed, was collected on ballast near Portland, Oregon, and occurs in portions of California. It is native to Uruguay and central Argentina. Barkworth (1990) mistakenly transferred it to *Nassella*. I apologize for any consequent confusion and thank those who brought it to my attention.

Achnatherum clandestinum (Hackel) Barkworth, *comb. nov.* BASIONYM: *Stipa clandestina* Hackel, Repert. Spec. Nov. Regni Veg. 8:516 (1910). LECTOTYPE: MEXICO. prope Michoacán; Arsène 3441 [designated by A.S. Hitchcock (1925)].

A.S. Hitchcock (1925) describes this species as occurring from northern México to Colombia. It is now established in Texas (Barkworth *et al.* 1989). Collections have also been made in San Luis Obispo, California (Curto 611, UTC 206571) but Curto stated later (*in litt.*) that it had since been eliminated from the garden where he found it. Because *Achnatherum clandestinum* has the potential for being a significant problem in rangelands, its spread should be strongly discouraged.

Achnatherum contractum (B.L. Johnson) Barkworth, *comb. nov.* BASIONYM: *Oryzopsis hymenoides* (Roemer & Schultes) Ricker var. *contracta* B.L. Johnson, Bot. Gaz. 107:24 (1945).

This species, which is known only from the Big Hollow area of southeastern Wyoming, is the fertile derivative of an *Achnatherum hymenoides* - *Piptatherum micranthum* (Trinius & Ruprecht) Barkworth hybrid (Shechter 1965; Shechter & Johnson 1966, 1968). I place it in *Achnatherum* because it is more similar to that genus than it is to *Piptatherum*.

Achnatherum coronatum (Thurber) Barkworth, *comb. nov.* BASIONYM: *Stipa coronata* Thurber in S. Watson, Bot. California 2:287 (1880). SYNTYPES: UNITED STATES. California: Julian; Bolander, and San Bernardino, Parry & Lemmon 422.

A.S. Hitchcock (1951) and others interpreted this species to include *Achnatherum parishii*, but it is generally larger than that species, has twice geniculate

awns, and paleas with shorter, less dense pubescence than *A. parishii*. It also tends to have somewhat longer trichomes at the top of its leaf sheath (1.25-4.40 mm, averaging 2.6 mm; rather than 0.7-4 mm, averaging 1.9 mm in *A. parishii* subsp. *parishii*). The range of *A. coronatum* extends from the San Francisco Bay area south through the coastal mountains to Baja California.

Achnatherum curvifolium (Swallen) Barkworth, *comb. nov.* BASIONYM: *Stipa curvifolia* Swallen, J. Wash. Acad. Sci. 23:456 (1933). HOLOTYPE: US 1538063!; UNITED STATES. New Mexico: Eddy County, Guadalupe Mountains; *Wilkins 1660*.

In the U.S.A., this species is known only from the Guadalupe Mountains of Texas and New Mexico and from Dona Ana County, New Mexico, but it also occurs in northern México.

Achnatherum diegoense (Swallen) Barkworth, *comb. nov.* BASIONYM: *Stipa diegoensis* Swallen, J. Wash. Acad. Sci. 30:212, f. 2 (1940). HOLOTYPE: US 1761177!; UNITED STATES. California: San Diego County; *Gander 5778*.

This species extends from San Diego County north to the Channel Islands of California (Ferren *et al.* 1986). It differs from other species of *Achnatherum* primarily in having distinctly pubescent nodes.

Achnatherum eminens (Cavanilles) Barkworth, *comb. nov.* BASIONYM: *Stipa eminens* Cavanilles, *Icon.* 5:42, pl. 46, f. 1 (1799). TYPE: MEXICO. Chalma.

Achnatherum hendersonii (Vasey) Barkworth, *comb. nov.* BASIONYM: *Oryzopsis hendersonii* Vasey, Contr. U.S. Natl. Herb. 1(8):267 (1893). TYPE: UNITED STATES. Washington: North Yakima, Clements Mountain; *Henderson 2249*.

Mehlenbacher (1970; Spellenberg & Mehlenbacher 1971) transferred this species to *Stipa* after demonstrating that it was closely related to *Stipa lemmonii* (Vasey) Scribner [= *Achnatherum lemmonii* (Vasey) Barkworth]. It is unusual in *Achnatherum* in having a shiny, indurate, glabrous floret. The indurate nature of the lemma reflects the relatively large number of layers between the two epidermal layers. The pattern of the outer epidermal layer is similar to that in most other species of *Achnatherum* (Thomasson 1976, 1978, 1979 [his "robusta" type]; Barkworth & Everett 1987).

Achnatherum hymenoides (Roemer & Schultes) Barkworth, *comb. nov.* BASIONYM: *Stipa hymenoides* Roemer & Schultes, *Syst. Veg.* 2:339 (1817). TYPE: UNITED STATES. banks of the Missouri River; *Bradbury*.

Achnatherum hymenoides has frequently been cited in discussions of generic limits within the Stipeae (Johnson & Rogler 1943; Johnson 1945a, 1945b, 1962, 1972; C.L. Hitchcock & Spellenberg 1968; Kam & Maze 1974; Barkworth & Everett 1987). Although it was usually placed in *Oryzopsis* because of its ovoid caryopsis and short, readily deciduous awn, it hybridizes with many of the species of *Stipa* that are here transferred to *Achnatherum*. It also, however, hybridizes with *Piptatherum micranthum* [= *Oryzopsis micrantha* (Trinius & Ruprecht) Thurber] (Shechter 1965; Shechter & Johnson 1966, 1968; see *Achnatherum contractum*), *Nassella viridula* (Trinius) Barkworth (Johnson & Rogler 1943; see \times *Achnella caduca* [Beal] Barkworth below), and *Hesperostipa neomezicana* (Weber 1957). Except in the case of *A. contractum*, the hybrids are completely sterile. Morphological and anatomical evidence support its inclusion in *Achnatherum* (Kam & Maze 1974; Barkworth & Everett 1987).

Achnatherum latiglume (Swallen) Barkworth, *comb. nov.* BASIONYM: *Stipa latiglumis* Swallen, J. Wash. Acad. Sci. 23:198, f. 1 (1933). HOLOTYPE: US 992334!; UNITED STATES. California: Yosemite Valley, Camp Lost Arrow; 22 June 1911; Abrams 4469.

Pohl (1954) demonstrated that *Achnatherum latiglume* is an allopolyploid derivative of *Stipa elmeri* Piper & Brodie ex Scribner [= *A. occidentale* (Thurber) Barkworth subsp. *pubescens*] and *S. lemmonii* [= *A. lemmonii*].

Achnatherum lemmonii (Vasey) Barkworth, *comb. nov.* BASIONYM: *Stipa pringlei* Scribner var. *lemmonii* Vasey, Contr. U.S. Natl. Herb. 3(1):55 (1892). TYPE: UNITED STATES. California: Plumas County; J.G. Lemmon 5456. *Stipa lemmonii* (Vasey) Scribner, U.S.D.A. Div. Agrostol. Circ. 30:3 (1901).

Stipa lemmonii (Vasey) Scribner var. *jonesii* Scribner, U.S.D.A. Div. Agrostol. Circ. 30:4 (1901). TYPE: UNITED STATES. California: Emigrant Gap; M.E. Jones 3298.

Achnatherum lemmonii (Vasey) Barkworth subsp. *pubescens* (Crampton) Barkworth, *comb. et stat. nov.* BASIONYM: *Stipa lemmonii* (Vasey) Scribner subsp. *pubescens* Crampton, Leaf. W. Bot. 7:220 (1955). HOLOTYPE: DAV!; UNITED STATES. California: Tehama County, Whitlock Camp-Round Mountain area west of Paskenta, serpentine slopes in chaparral, elevation about 4000 ft; 16 June 1954; Crampton 2000.

Crampton cited two specimens in his description of the species, the type collection and Suksdorf 8661. Dibble & Griggs (1979) observed plants in three populations in Tehama and Lake counties, California. They noted that the most pubescent plants were on decomposed serpentine soils, those with intermediate pubescence were on undecomposed serpentine, and glabrous plants

were on nonserpentine soils. Barkworth & Linman (1984) argued against recognition of *Stipa lemmonii* var. *pubescens* because specimens with varying degrees of pubescence occurred throughout the range of the species, on both serpentine and non-serpentine soils. The specimens they examined included two duplicates of *Suksdorf 8661* but not *Crampton 2000*, the type of var. *pubescens*. In 1987, I borrowed the type and other specimens of var. *pubescens* from DAV and discovered that, unlike the other pubescent specimens (including *Suksdorf 8661*), they were densely tomentose rather than villous. I therefore decided to recognize Crampton's taxon but consider it to be restricted to Tehama and Lake counties of California.

Achnatherum lettermanii (Vasey) Barkworth, *comb. nov.* BASIONYM: *Stipa lettermanii* Vasey, Bull. Torrey Bot. Club 13:53 (1886). TYPE: US556904!; UNITED STATES. Idaho: Snake River; *G.W. Letterman 102*.

Achnatherum lobatum (Swallen) Barkworth, *comb. nov.* BASIONYM: *Stipa lobata* Swallen, J. Wash. Acad. Sci. 23:199, f. 2 (1933). HOLOTYPE: US905722!; UNITED STATES. New Mexico: Guadalupe Mountains, Queen Ranger Station; *A.S. Hitchcock 13502*.

Achnatherum nelsonii (Scribner) Barkworth, *comb. nov.* BASIONYM: *Stipa nelsonii* Scribner, U.S.D.A. Div. Agrostol. Bull. 11:46 (1898). TYPE: US 556901!; UNITED STATES. Wyoming: Albany; *A. Nelson 3963*.

Achnatherum nelsonii (Scribner) Barkworth subsp. *dorei* (Barkworth & Maze) Barkworth, *comb. nov.* BASIONYM: *Stipa nelsonii* Scribner subsp. *dorei* Barkworth & Maze, Taxon 28:623 (1979). TYPE: DAO!; CANADA. Alberta: Dungarvan Creek; *W.G. Dore 12136*.

Achnatherum nelsonii (Scribner) Barkworth subsp. *longiaristatum* (Barkworth & Maze) Barkworth, *comb. et stat. nov.* BASIONYM: *Stipa nelsonii* Scribner var. *longiaristata* Barkworth & Maze, Taxon 28:623 (1979). TYPE: WS!; UNITED STATES. Washington: 8-9 mi west of Spokane; *J.S. Swallen 6231*.

This taxon is a puzzling entity. If the hairs on its awns were longer, it would fit easily within *Achnatherum californicum*. I have elevated it to a subspecies because it is as morphologically and geographically distinct from subsp. *nelsonii* as is subsp. *dorei*.

Achnatherum nevadense (B.L. Johnson) Barkworth, *comb. nov.* BASIONYM: *Stipa nevadensis* B.L. Johnson, Amer. J. Bot. 49:257 (1962). TYPE: UC; UNITED STATES. California: Mono County, Upper Twin Lake, near Bridgeport; *B.L. Johnson 211*.

Johnson (1962) demonstrated that this species is an allopolyploid derivative of *Achnatherum lettermanii* and *A. occidentale*.

***Achnatherum occidentale* (Thurber) Barkworth, *comb. nov.* BASIONYM:** *Stipa occidentalis* Thurber in S. Watson in King, *Geol. Expl. 40th Parallel* 5:380 (1871). TYPE: GH!; UNITED STATES. California: Yosemite Trail; *Bolander 5038*.

***Achnatherum occidentale* (Thurber) Barkworth subsp. *pubescens* (Vasey) Barkworth, *comb. nov.* BASIONYM:** *Stipa viridula* Trinius var. *pubescens* Vasey, *Contr. U.S. Natl. Herb.* 3(1):50 (1892). TYPE: UNITED STATES. Washington: Columbia River; *Suksdorf s.n.* [Isotype: US 79560!]. *Stipa occidentalis* Thurber var. *pubescens* (Vasey) Maze, Taylor, & MacBryde, *Canad. J. Bot.* 56:193 (1978).

Stipa elmeri Piper & Brodie ex Scribner, U.S.D.A. Div. Agrostol. Bull. 11:46 (1898).

This species is interpreted as comprising only plants with pilose awns, i.e., A.S. Hitchcock's (1951) *Stipa occidentalis*, *S. elmeri*, and *S. californica* Merrill & Burt Davy but not *S. nelsonii*, *S. williamsii* Scribner, or *S. columbiana* Macoun. Specimens from lower elevations (generally below 3000 m) are pilose only on the first two awn segments whereas those from higher elevations are often pilose on at least the lower portion of the third segment, with some specimens, including the holotype, being pilose throughout. Higher elevation plants also tend to be shorter and have narrower leaf blades with denser adaxial pubescence than do plants from lower elevations. The name *Achnatherum occidentale* subsp. *pubescens* refers to the relatively large, lower elevation plants (Maze 1965; Taylor & MacBryde 1978).

***Achnatherum occidentale* (Thurber) Barkworth subsp. *californicum* (Merrill & Burt Davy) Barkworth, *comb. nov.* BASIONYM:** *Stipa californica* Merrill & Burt Davy, *Univ. Calif. Pub. Bot.* 1:61 (1902). TYPE: UNITED STATES. California: San Jacinto Mountains; *Hall 2556*.

Maze (1962, 1965), whose recommendations were adopted by C.L. Hitchcock (1969), expanded *Achnatherum occidentale* (as *Stipa occidentalis*) to include *S. californica*, *S. nelsonii*, and *S. columbiana*. I concur with Maze with respect to *S. californica*, as is indicated by the above combination, but prefer to use subspecific rather than varietal rank for major infraspecific taxa with a tendency to occupy different geographic areas. I regard the scabrous awned taxa as specifically distinct (see *A. nelsonii*) although there are intermediates between *A. occidentale* and *A. nelsonii*.

Achnatherum papposum (Nees) Barkworth, *comb. nov.* BASIONYM: *Stipa papposa* Nees in C. Martius, *Fl. Bras. Enum. Pl.* 2:377 (1829). TYPE: B; Isotype: US 993503 [Hitchcock (1925); [URUGUAY]. ad Monte-Video; *Sellow*.

This South American species was collected in Berkeley, California, in 1983. So far as I am aware, it has not become established. It differs from all other North American species in the U.S. and Canada in bearing divergent, long hairs at the top of the lemma.

Achnatherum parishii (Vasey) Barkworth, *comb. nov.* BASIONYM: *Stipa parishii* Vasey, *Bot. Gaz.* 7:33 (1882). TYPE: UNITED STATES. California: San Bernardino Mountains; *Parish 1079*.

This species differs from *Achnatherum coronatum* in having once geniculate awns and more densely pubescent paleas. It extends from the San Bernardino Mountains east to Nevada and Arizona.

Achnatherum parishii (Vasey) Barkworth subsp. **depauperatum** (M.E. Jones) Barkworth, *comb. et stat. nov.* BASIONYM: *Stipa parishii* Vasey var. *depauperata* M.E. Jones, *Contr. W. Bot.* 14:11 (1912). TYPE: UNITED STATES. Utah: Detroit [a now vanished mining town]; *M.E. Jones*.

Subsp. *depauperatum*, as its name suggests, consists of smaller plants than subsp. *parishii*. It also either lacks or has very short (0.1-0.5 mm) trichomes at the top of its leaf sheaths. It occurs in central, southern, and eastern Nevada and western Utah. A.S. Hitchcock (1925, 1935, 1951) did not distinguish it from subsp. *parishii*.

Achnatherum perplexum Hoge & Barkworth, *spec. nov.* HOLOTYPUS: US!; UNITED STATES. New Mexico: Bernalillo County, 1.5 mi east on USFS road 413, 9 mi south of Tijeres on NM 14; 8 September 1985; *M.E. Barkworth 4764*.

Ab *A. lobatum* (Swallen) Barkworth brevioribus lobis lemmatum et generaliter angustioribus laminis foliorum; ab *A. nelsonii* (Scribner) Barkworth subsp. *dorei* (Barkworth & Maze) Barkworth ciliatis ligulis divergentibus acuminatis glumis recedit.

Plants perennial, caespitose, branching intravaginally. Culms 30-70 cm, mostly glabrous, sometimes scabrous or puberulent below the nodes. Sheaths usually longer than the internodes, glabrous to scabrous, the margins sometimes ciliate; ligules 0.3-0.8 mm long, ciliate; blades 1-3 mm wide, scabrous.

Panicle 6-20 cm long, 1-2 cm wide; branches ascending, often with one very shortly pedicellate or even sessile spikelet. Glumes unequal, scabrous, 3 to obscurely 5 veined, the midvein extending to the apex; lower glume 9-14 mm long, 1.5-2.5 mm wide; second glume 7.5-10.5 mm long, 1.0-1.6 mm wide; callus 0.50-0.85 mm long, blunt; lemma 4.5-6.5 mm long, evenly pubescent, the midbody hairs 0.45-1.0 mm long, the apical hairs 0.9-1.8 mm long; lemma lobes 0.15-0.45 mm long; palea 2.5-3.75 mm long; awn 10.4-19.0 mm long, usually once geniculate; anthers 2.25-4.20 mm long.

One of the most distinctive features of this species is that it flowers in late summer, with fruit maturation occurring in September, whereas our other species of *Achnatherum* flower in late spring to early summer. Electrophoretic data also support recognition of *A. perplexum* as a distinct taxon (Hoge 1992). Existing specimens tend to have been identified as *A. nelsonii* subsp. *dorei* if they were collected in the northern portion of its range and as *A. lobatum* if they were collected in the southern portion of its range. So far as is known, *A. perplexum* is restricted to the southwestern U.S.A.

Achnatherum pinetorum (M.E. Jones) Barkworth, *comb. nov.* BASIONYM: *Stipa pinetorum* M.E. Jones, Proc. Calif. Acad. Sci., Ser. 2 5:724 (1895). NEOTYPE, designated here: US 236788!; UNITED STATES. Utah: Panguitch Lake; M.E. Jones 6023.

The neotype is an isotype of the holotype that was deposited in RSA but has since been lost (pers. comm., S. Boyd).

Achnatherum richardsonii (Link) Barkworth, *comb. nov.* BASIONYM: *Stipa richardsonii* Link, Hort. Berol. 2:245 (1833). TYPE: Grown at Berlin from seed sent by Richardson.

There is now no specimen corresponding to the type of *Achnatherum richardsonii* in B. A neotype needs to be designated by someone able to search the appropriate herbaria. The species is sufficiently distinctive that lack of a type specimen has not presented a problem.

Achnatherum robustum (Vasey) Barkworth, *comb. nov.* BASIONYM: *Stipa viridula* Trinius var. *robusta* Vasey, Contr. U.S. Natl. Herb. 1(3):56 (1890). PROPOSED CONSERVED TYPE: US 993051!; UNITED STATES. New Mexico: G.R. Vasey s.n.

The type of *Stipa viridula* var. *robusta* designated by Vasey belongs to *Achnatherum lobatum*. The two taxa are quite distinct, the most reliable identifying features being the pubescent collar of *A. robustum* and the short, glabrous palea of *Nassella viridula* [= *Stipa viridula*]. These are present on all

specimens, the collar pubescence of *A. robustum* being particularly well developed on the uppermost leaf. *Achnatherum lobatum* and the type of *S. viridula* var. *robusta* selected by Vasey lack this pubescence but have the long lemma lobes that are characteristic of *A. lobatum*. The two species are superficially similar, but the *robusta* epithet has consistently been applied to the tall, stout species with a large, dense panicle that is found from Wyoming to northern México, but not in Trans Pecos, Texas. The name *S. lobata* has consistently been applied to a southern taxon with long lemma lobes.

The type specimen cited above fits the interpretation of *Stipa robusta* (Vasey) Scribner found in all existing floras (e.g., Hitchcock 1951; Gould 1975). The principle of priority would require that the name *S. robusta* be applied to *S. lobata* and a new name be found for the species currently called *S. robusta* because the combination *S. robusta* was published (Scribner 1897) before *S. lobata* (Swallen 1933). Fortunately, the current edition of the *International Code of Botanical Nomenclature* (Greuter et al. 1988) permits designation of a different specimen as the type of a species if it can be shown that it would lead to greater nomenclatural stability without creating confusion. I have submitted a paper (Barkworth, submitted) to the Nomenclatural Committee of the International Committee of Plant Taxonomists in which I propose that this option be exercised in order to conserve the application of both *S. robusta* and *S. lobata*. Until the Committee reaches a decision, the Code requires that the two names continue to be used in their customary sense.

Achnatherum scribneri (Vasey) Barkworth, *comb. nov.* BASIONYM: *Stipa scribneri* Vasey, Bull. Torrey Bot. Club 11:125 (1884). TYPE: US 556905!; UNITED STATES. New Mexico: Santa Fe; Vasey s.n.

Because I confused this species with *Achnatherum parishii*, Peterson & Annable (1986) reported that it was present in California. Both species have longer hairs at the lemma apex than below and are ciliate at the top of the leaf sheath, but *A. scribneri* has an elongate, sharp callus and *A. parishii* has a blunt callus.

Achnatherum speciosum (Trinius & Ruprecht) Barkworth, *comb. nov.* BASIONYM: *Stipa speciosa* Trinius & Ruprecht, Mém. Acad. Imp. Sci. Saint-Petersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 5(1):45 (1842). TYPE: LE!; CHILE. *Cuming.*

Achnatherum splendens (Trinius) Nevski

A.S. Hitchcock (1951) reported that this species was sometimes cultivated in the U.S.A. I have not seen any specimens to document his report. In China, it is planted to protect the edges of irrigation ditches and to control erosion (Lu & Kuo 1987).

Achnatherum stillmanii (Bolander) Barkworth, *comb. nov.* BASIONYM: *Stipa stillmanii* Bolander, Proc. Calif. Acad. Sci. 4:169 (1872). TYPE: UNITED STATES. California: Sierra Nevada, Blue Canyon; 1870; Bolander.

Achnatherum stillmanii, a Californian endemic, differs from the other North American species of *Achnatherum* in its shortly rhizomatous, but tufted, growth form, greater height, awnlike lemma lobes, extruded paleal veins, and lemma epidermal pattern. Morphological and anatomical data suggest that its nearest relatives are in northern India and Tibet.

Achnatherum swallenii (C.L. Hitchcock & Spellenberg) Barkworth, *comb. nov.* BASIONYM: *Oryzopsis swallenii* C.L. Hitchcock & Spellenberg, Brittonia 20:164 (1968). HOLOTYPE: WTU 227273; UNITED STATES. Idaho: Clark County, just north of Birch Creek, along Highway 28, near the Lemhi County line; C.L. Hitchcock 23868.

In describing this species, C.L. Hitchcock & Spellenberg (1968, p. 164-5) stated that it had "...the floral features traditionally associated with *Oryzopsis* ...[but] is, in some respects, both morphologically and cytologically at least as similar to species usually referred to *Stipa*" and suggested that a revision of the generic boundaries might be appropriate.

Achnatherum thurberianum (Piper) Barkworth, *comb. nov.* BASIONYM: *Stipa thurberiana* Piper, U.S.D.A. Div. Agrostol. Circ. 27:10 (1900). TYPE: UNITED STATES. Washington: north branch of the Columbia and Okanagan; Pickering & Brackenridge.

Achnatherum webberi (Thurber) Barkworth, *comb. nov.* BASIONYM: *Eriocoma webberi* Thurber in S. Watson, Bot. Calif. 2:283 (1880). TYPE: UNITED STATES. California: Sierra Valley; Bolander. *Oryzopsis webberi* (Thurber) Bentham ex Vasey, Grasses U.S. 23 (1883). *Stipa webberi* (Thurber) B.L. Johnson, Bot. Gaz. 107:25 (1945).

Achnatherum ×bloomeri (Bolander) Barkworth, *comb. nov.* BASIONYM: *Stipa bloomeri* Bolander, Proc. Calif. Acad. Sci. 4:168 (1872). TYPE: UNITED STATES. California: Bloody Canyon, near Mono Lake. *Oryzopsis bloomeri* (Bolander) Ricker, Contr. U.S. Natl. Herb. 11:109 (1906). ×*Stiporyzopsis bloomeri* (Bolander) B.L. Johnson, Amer. J. Bot. 32:602 (1945).

As noted above, *Achnatherum hymenoides* forms sterile hybrids with numerous species of *Achnatherum*. The hybrids are easily identified by their long and abundant lemma hairs and the intermediate shape of their glumes

and florets. Johnson (1945b) provided a key for identifying the second parent. According to the *International Code of Botanical Nomenclature* (Greuter *et al.* 1988), the name *A. ×bloomeri* applies only to hybrids between *A. hymenoides* and *Stipa occidentalis*. I see no value in proposing individual binomials for the other hybrids.

× *ACHNELLA* Barkworth, *hybr. gen. nov.*
= *ACHNATHERUM* P. Beauvois × *NASSELLA* Desvaux

× *Achnella* Barkworth, *hybr. gen. nov.*
= *Achnatherum* P. Beauvois × *Nassella* Desvaux

× *Achnella caduca* (Beal) Barkworth, *comb. nov.* BASIONYM: *Oryzopsis caduca* Beal, Bot. Gaz. 15:111 (1890). TYPE: UNITED STATES. Montana: Belt Mountains; *Scribner*.

Johnson & Rogler (1943) showed that × *Achnella caduca* refers to sterile hybrids between *Nassella viridula* and *Achnatherum hymenoides*. Hitchcock (1951) included them in *Achnatherum ×bloomeri*. × *Achnella caduca* differs from this and other intrageneric hybrids involving *A. hymenoides* in having sparsely pubescent sheath throats, stiffer lemmas with seven, rather than five, veins and anthers of two different lengths. Each of these characteristics is found in *N. viridula*.

HESPEROSTIPA (Elias) Barkworth, *stat. nov.*

Hesperostipa (Elias) Barkworth, *stat. nov.* BASIONYM: *Stipa* sect. *Hesperostipa* Elias, Special Pap. Geol. Soc. Amer. 41:67 (1942). TYPE: *Hesperostipa comata* (Trinius & Ruprecht) Barkworth [= *Stipa comata* Trinius & Ruprecht].

Plants densely caespitose. Ligules membranous. Panicles usually contracted. Glumes exceeding the floret, lanceolate, long tapering; floret 7.5-25 mm long, 1.0-1.5 mm in diameter, narrowly cylindrical; callus 2.5-5.0 mm, sharp; lemmas indurate, margins not overlapping, the upper portion fused and lacking apical lobes; awn 65-180 mm long, persistent and twice geniculate, the proximal sections twisted, the distal section straight, or flexuous to somewhat curled; palea subequal to the lemma, prow tipped, its veins extending to the apical margin. Name from Greek, *hesperos*, west, and *Stipa*.

Hesperostipa is endemic to North America. Superficially, its members appear close to the Eurasian *Stipa* sensu stricto because both have conspicuous morphological features that are adaptive to seasonally dry grassland habitats,

e.g., large, elongate fruits, sharp calluses, indurate lemmas, and long, persistent awns, features that help bury the seeds to a depth where soil moisture is adequate for successful establishment (Misra 1961). The palea structure, epiblast morphology, and lemma epidermal pattern all indicate that the closest extant relatives of *Hesperostipa* are the primarily South American genera *Piptochaetium* and *Nassella* (Barkworth & Everett 1987; Barkworth 1990).

Hesperostipa comata (Trinius & Ruprecht) Barkworth, *comb. nov.* BASIONYM: *Stipa comata* Trinius & Ruprecht, Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 5(1):75 (1842). HOLOTYPE: LE!; CANADA. Carlton House Fort, Saskatchewan River; *Drummond*.

Hesperostipa comata (Trinius & Ruprecht) Barkworth subsp. *intermedia* (Scribner & Tweedy) Barkworth, *comb. et stat. nov.* BASIONYM: *Stipa comata* Trinius & Ruprecht var. *intermedia* Scribner & Tweedy, Bot. Gaz. 11:171 (1886). HOLOTYPE: US!; UNITED STATES. Wyoming: Yellowstone Park, Junction Butte, 6000 ft; *Tweedy 610*.

Hesperostipa curtisetia (Hitchcock) Barkworth, *comb. nov.* BASIONYM: *Stipa spartea* Trinius var. *curtiseta* A.S. Hitchcock, Contr. U.S. Natl. Herb. 24(7):230 (1925). HOLOTYPE: US!; UNITED STATES. Montana: Hound Creek Valley; *Scribner 339*.

Hesperostipa neomexicana (Thurber) Barkworth, *comb. nov.* BASIONYM: *Stipa pennata* L. var. *neomexicana* Thurber in J.M. Coulter, *Man. Bot. Rocky Mt.* 408 (1885). TYPE: UNITED STATES. New Mexico: Rio Mimbres; *Thurber 269*. *Stipa neomexicana* (Thurber) Scribner, *Amer. Grasses II*, 132, f. 428 (1899).

Weber (1957) reported a single plant that seemed, from what he described as circumstantial evidence, to be a hybrid between *Achnatherum hymenoides* and *Hesperostipa neomexicana*. It was completely sterile.

Hesperostipa spartea (Trinius) Barkworth, *comb. nov.* BASIONYM: *Stipa spartea* Trinius, Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math. 1:82 (1830). HOLOTYPE: LE!; North America: Rocky Mountains; "*Hook. Cat. 253*".

NASSELLA Desvaux

Plants caespitose. Culms unbranched (ours) or branched. Margins of basal leaves often ciliate at the throat. Glumes 5-22 mm long, tapering from near the base to the narrowly acute tip, often anthocyanic; floret terete or laterally compressed, 1-many times longer than wide; lemma indurate, papillose or tuberculate, at least above, variously pubescent, the margins strongly overlapping; lemma apex fused, forming a more or less evident neck, this often pale in color, restricted at the base, and crowned with bulbous based hairs; awn varying from short to long, short awns being associated with short, more rounded florets and long awns with cylindrical florets; palea $1/3$ or less the length of the lemma, glabrous, ecostate, rounded at the tip; anthers 1, 2, or 3, ciliate, often dimorphic within a floret. LECTOTYPE: *Nassella pungens* Desvaux (Parodi 1947; Barkworth 1990). Name diminutive of Latin, *nassa*, a wicker basket with a narrow neck, a reference to the florets of some South American species.

The need to expand the traditional interpretation of *Nassella* has been discussed elsewhere (Barkworth 1990) and the necessary combinations made.

Nassella cernua (Stebbins & Love) Barkworth.

Nassella formicarum (Delile) Barkworth. This species is established at several sites in California and was probably introduced in the last century or early this century.

Nassella lepida (Hitchcock) Barkworth, including *Stipa lepida* Hitchcock var. *andersonii* (Vasey) Hitchcock. The variety supposedly differs in having more slender culms and a narrow, reduced panicle but the variation appears to be continuous. Crampton (1988, *in litt.*) observed that plants in old, unburned stands of chaparral are often reduced but plants re-established or regenerating after burns or soil disturbance are far more robust and have rather ample panicles.

Nassella leucotricha (Trinius & Ruprecht) Pohl.

Nassella neesiana (Trinius & Ruprecht) Barkworth. This species has been found in the past on ballast dumps in the U.S.A. but there have been no recent collections.

Nassella pulchra (Hitchcock) Barkworth.

Nassella tenuissima (Hitchcock) Barkworth.

Nassella viridula (Trinius) Barkworth.

ORYZOPSIS Michaux

Inflorescence an open or closed panicle. Glumes acute, mucronate, or rounded; florets terete or laterally compressed; calluses blunt; lemmas coriaceous to indurate, their margins at least partially overlapping at maturity; awn 1-15 mm long, caducous or persistent, almost straight to once or twice geniculate and twisted below. TYPE: *Oryzopsis asperifolia* Michaux. Name from Latin *oryza*, rice, and Greek *-opsis*, like.

Oryzopsis, as treated here, is polyphyletic. Its type species, *O. asperifolia*, is quite different from the other three species (Kam & Maze 1974). Several features suggest that it is only distantly related to other Stipeae, including the other three species of *Oryzopsis*. These features include its twisted basal leaf blades, rudimentary cauline leaf blades, unusual callus pubescence, lemma epidermal pattern, leaf blade cross section, and floret development (Kam & Maze 1974). The problem is determining how to treat the other North American species traditionally included in *Oryzopsis*. Many belong in *Achnatherum*, q.v. Two belong in *Piptatherum*. This leaves three problem species, *O. exigua* Thurber, *O. canadensis* (Poiret) Torrey, and *O. pungens* (Torrey) Hitchcock. Morphologically, *O. canadensis* and *O. pungens* are quite similar, differing chiefly in the length and persistence of their awns, but *O. exigua* is quite distinct. The lemma epidermal patterns of the three are similar but, because I am not convinced they form a natural group, I have left them in *Oryzopsis* for the sake of nomenclatural stability.

Oryzopsis asperifolia Michaux.

Oryzopsis canadensis (Poiret) Torrey.

Oryzopsis exigua Thurber.

Oryzopsis pungens (Torrey) Hitchcock.

PIPTATHERUM P. Beauvois

Plants perennial, with intra- or extravaginal branching. Ligules 0.2-15 mm long; blades flat, involute, or folded. Panicle open or contracted, the secondary branches frequently appressed to the primary branches. Glumes subequal, obtuse to acute or acuminate; florets dorsally compressed; callus 0.1-0.5 mm, blunt, the disarticulation scar round or horizontal; lemma dark brown or black, coriaceous to indurate, from dull to shiny, only covering the margins of the palea at maturity; awn straight to somewhat twisted, readily deciduous; palea similar to the lemma in length and texture. TYPE: *Piptatherum coerulescens* (Desfontaines) P. Beauvois. Name from Greek *pipto*, fall, and *ather*, awn.

Freitag (1975) restricted *Piptatherum* to Eurasian species that were otherwise placed in *Oryzopsis*, but the only North American species he examined was *O. asperifolia*. Morphologically, *Piptatherum racemosum* (Smith) Barkworth and *P. micranthum* are so similar to the Eurasian species that it is hard to understand their exclusion. Johnson (1945a) found the North American species of *Oryzopsis* had a different base number from the Eurasian species (11 rather than 12) and slightly shorter chromosomes. This does not seem adequate reason to exclude them from *Piptatherum* given morphological similarity to other members of the genus. The lemma epidermal pattern and leaf anatomy of these two species also argues for their association with the Eurasian species (Barkworth & Everett 1987; Barkworth, unpub. data). The third species listed, *P. miliaceum* (L.) Cosson, is a Eurasian introduction.

Piptatherum micranthum* (Trinius & Ruprecht) Barkworth, *comb. nov.

BASIONYM: *Urachne micrantha* Trinius & Ruprecht, Mém. Acad. Imp. Sci. Saint-Petersbourg, Sér. 6., Sci. Math., Seconde Pt. Sci. Nat. 5(1):16 (1842). TYPE: North America [from Saskatchewan]. *Oryzopsis micrantha* (Trinius & Ruprecht) Thurber, Proc. Acad. Nat. Sci. Philadelphia 1863:78 (1863).

***Piptatherum miliaceum* (L.) Cosson**

***Piptatherum racemosum* (Smith) Barkworth, *comb. nov.* BASIONYM:**

Milium racemosum Smith in Rees, *Cycl.* 23: *Milium* No. 15 (1813). TYPE: UNITED STATES. Pennsylvania: Lancaster; Muhlenberg. *Oryzopsis racemosa* (Smith) Ricker in Hitchcock, *Rhodora* 8:210 (1906).

PIPTOCHAETIUM* Presl, *nom. cons.

Blades with translucent lines between the veins. Glumes equal, longer than the floret, lanceolate, 3, 5, or 7 veined, becoming acuminate; floret usually round in cross section, from globose to cylindrical; callus usually sharp; lemma indurate, striate, often papillose above; lemma margins involute, fitting into the longitudinal groove of the palea; lemma apex fused; awn usually twice geniculate, varying from readily caducous to persistent; palea slightly longer than the lemma but similar in texture, longitudinally grooved, its apex prowl tipped.

Parodi (1944) presented an excellent revision of *Piptochaetium*, which was ignored by North American taxonomists until Thomasson (1976, 1978, 1979) provided additional evidence supporting Parodi's treatment of the genus.

***Piptochaetium avenacoides* (Nash) Valencias & Cabrerias**

Piptochaetium avenaceum (L.) Parodi

Piptochaetium fimbriatum (Kunth) Hitchcock

Piptochaetium pringlei (Scribner) Parodi

Piptochaetium setosum (Trinius) Arechavaleta. This species has become established in Marin County, California. Like *Piptochaetium stipoides* (Trinius & Ruprecht) Hackel, it has a distinct neck, but unlike that species, the neck is more or less straight whereas the neck in *P. stipoides* looks like a stiff collar that has been rolled over to expose a densely papillate adaxial surface.

PTILAGROSTIS Grisebach

Plants densely cespitose; basal branching intravaginal. Blades filiform. Panicle open or closed. Glumes hyaline, ecostate or with 1 weak vein; callus blunt; lemma coriaceous, pubescent, lobed but not fused at the apex; awn often plumose below (but not in *Ptilagrostis kingii* [Bolander] Barkworth); palea similar in length and texture to the lemma, 2 veined, the veins terminating before the rounded, flat apex. TYPE: *Ptilagrostis mongholica* (Trinius) Grisebach. Name from Greek *ptilo-*, down (as in feather), and *Agrostis*, a forage grass.

Ptilagrostis was first recognized as occurring in North America by Weber (1966, 1976). Barkworth (1983) transferred the high altitude Californian endemic, *P. kingii*, to the genus, thereby expanding its North American representation to two taxa.

Ptilagrostis mongholica (Trinius) Grisebach subsp. *porteri* (Rydberg) Barkworth

Ptilagrostis kingii (Bolander) Barkworth

STIPA L.

As I interpret the genus, *Stipa* is not part of North America's native flora. A.S. Hitchcock (1951) lists four species as being occasionally cultivated in the U.S.A. One of these, *S. splendens* Trinius, is listed above as *Achnatherum splendens*. *Stipa pennata* L. is the type of *Stipa* and, hence, necessarily included in *Stipa*. *Stipa tenacissima* L. also belongs in that genus according to my interpretation, but I do not know the most appropriate treatment for the

Australian *S. elegantissima* Labillardière. It does not belong in *Stipa* sensu stricto but, until a definitive study is completed, nomenclatural stability is best served by keeping it there.

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WHY DON'T WEST LOUISIANA BOGS AND GLADES GROW UP INTO FORESTS?

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ABSTRACT

We studied trees in bogs, glades, and pinewoods in the Kisatchie National Forest, Louisiana, to determine tree species size and density. Bogs and glades are relatively open habitats with stunted trees, many of which are old growth. One reason why trees do not grow well in these habitats involves edaphic factors. The soil is nutrient poor, it is underlain by an impermeable layer, and it is either waterlogged or dry much of the year. Fire is probably more important in keeping bogs open, while desiccation is probably the most important factor for glades.

KEY WORDS: Tree growth, forest opening, bog, glade, Kisatchie National Forest, Louisiana

INTRODUCTION

There are two naturally open terrestrial habitats in the Kisatchie Ranger District of the Kisatchie National Forest. These are bogs, often referred to as hillside seepage bogs or pitcher plant bogs, and glades. Bogs are open, species rich environments which are hydric but not inundated, and which have acidic and nutrient poor soils. Glades are xeric, species poor environments often with sandstone at or near the surface with thin nutrient poor acidic soils (MacRoberts & MacRoberts 1990, 1991, 1992a, 1992b; Frost *et al.* 1986; Martin & Smith 1991; Nixon & Ward 1986; Streng & Harcombe 1982).

In this paper we address the question: why are these habitats open? Since trees and woody vegetation grow in them and both are subject to invasion by woody plants and herbaceous weeds, some factor or factors must be keeping this vegetation out (DeSelm 1986). Among reasons that have been suggested are fire frequency and intensity, poor soils, and hydric conditions. Streng &

Harcombe (1982), for example, have studied this problem in similar habitats in southeastern Texas and have found that edaphic factors may be responsible for keeping grass/sedge meadows open, while pyric factors appear to be responsible for keeping bluestem savannas open. Other workers have made similar suggestions about various open habitats in the eastern United States (see Frost *et al.* 1986; and Olson 1992; reviews including relevant literature).

METHODS

We made five sets of observations for this study.

I. To compare the spatial distribution and size of trees in glades with those of bogs and pinewoods, we ran transects through the middle of five glades. These totaled an area 416 meters long and 3 meters wide (1248 square meters). Within this area we mapped all trees over 1.5 meters tall, measured their diameter at breast height (dbh), and recorded their species. We had previously collected these same data for bogs and pinewoods (MacRoberts & MacRoberts 1990).

II. We cut at ground level four small longleaf pines from each of three samples of each habitat; that is, a total of twelve trees from bogs, twelve trees from glades, and twelve trees from pinewoods. The sample was matched for size (tree height and diameter) and for the amount of solar radiation received (the twelve trees from pinewoods were taken from areas that had been clearcut, that had grown up since the cut; otherwise they would not have received the same solar radiation as trees from bogs or glades). The trees were measured and photographed and a cross section from the base of each was preserved for later microscopic examination. The purpose of these observations was to determine the growth rate of pines in different habitats.

III. We made increment borings of seven "relict" longleaf pines (dbh 28-38 cm) in two glades and one longleaf pine (dbh 33 cm) in a pinewoods. Relict trees are trees that were not cut during the "big cutover" that occurred in the early part of this century (Caldwell 1991); they are often flat topped, stunted, and have few branches. Our purpose here as in II, was to gain insight into growth rates of longleaf pines in these habitats.

IV. In each of five glades and five bogs we randomly selected ten temporary one meter square plots, giving us fifty one meter square plots for each habitat. In each plot, we counted pine seedlings (first and second year plants) to see if pine establishment differed among these habitats and could shed light on tree productivity. We did not collect the same data for pinewoods since it is obvious that pine germination is optimal in that habitat. We counted the trees in the plots in July 1991.

V. We followed the fate of pine seedlings in four permanent plots: two in a glade and two in a bog. The plots were established in March 1991 and re-

Table 1. Number of trees by species and their size in glade transects.

Species	No. in Glades	Average dbh (cm) (range)
<i>Pinus palustris</i>	25	14.0 (1.5-41)
<i>P. taeda</i>	18	8.4 (2-33)
<i>P. echinata</i>	3	3.5 (3-4)
<i>Quercus marilandica</i>	6	10.3 (1-25)
<i>Q. stellata</i>	1	16.0

examined periodically until November 1992 to determine survivorship of pine seedlings in these two habitats.

RESULTS

The results of our observations on item I above are in Tables 1 through 3. These tables are almost identical to Tables 1 through 3 in our previous paper on the size distribution and density of trees in bogs and pine woodlands (MacRoberts & MacRoberts 1990), and those tables should be consulted for information not repeated here. Table 4 summarizes the results of the present observations and our previous observations on bogs and pinewoods. In pinewoods there was one tree per eleven square meters, in glades there was one tree per 23.5 square meters, and in bogs there was one tree per 35 square meters. Median tree sizes in glades, bogs, and pinewoods (Table 2) were significantly different (median test, χ -square = 5.99, $P < .05$). We did not do a formal, a posteriori pairwise test of the three habitats, but it is clear by inspection that the pinewoods contributed most to that difference. The growth rate of trees in bogs, glades, and pinewoods as measured by rings per cm (see Table 5) was significantly different among habitats (ANOVA, $P < .001$). An a posteriori test showed that the mean for each habitat was significantly different from the mean of each other habitat. As Figure 1 shows, trees in pinewoods grow much faster than trees in bogs, which in turn are faster growing than trees in glades. The correlation coefficients between age (number of rings) and tree height and diameter are high (between .73 and .89) and are significant at the .01 level for both measures (height/age, diameter/age) in all three habitats. It is therefore possible to accurately predict the age of a tree (knowing the habitat) from either its height or its diameter.

In this regard our increment borings (cores) are interesting. We found that the larger pines in glades (between 28-38 cm dbh) ranged from about 120 to 380 years old and are thus truly old growth, while one tree of comparable size (33 cm dbh) from a pinewoods was only about 50 years old. Martin & Smith

Table 2. Tree size in glade, pinewood, and bog transects.

Diameter Class dbh (cm)	No. of Trees		
	Glade	Pinewoods	Bog
1-5	19	24	19
5-10	12	18	7
10-15	6	17	3
15-20	8	12	5
20-25	3	8	0
25-30	2	14	2
30-35	2	18	0
35-40	0	7	0
40-45	1	0	0

Table 3. Size of *Pinus* in glade transects.

Diameter Class dbh (cm)	No. of Trees			
	Longleaf	Loblolly	Shortleaf	Total
1-5	3	9	3	15
5-10	7	5	0	12
10-15	5	1	0	6
15-20	5	2	0	7
20-25	2	0	0	2
25-30	1	0	0	1
30-35	1	1	0	2
35-40	0	0	0	0
40-45	1	0	0	1

Table 4. Comparison of trees in transects of equal size in bogs, glades, and pinewoods (all measurements in cm).

	Habitat		
	Bogs	Glades	Pinewoods
No. of Trees	36	53	118
Mean tree dbh	7.8	11.1	16.8
Range	1-28	1-41	1-40

Figure 1. Regression slope of tree height and diameter as an expression of age in *Pinus palustris* in pinewoods, bogs, and glades.

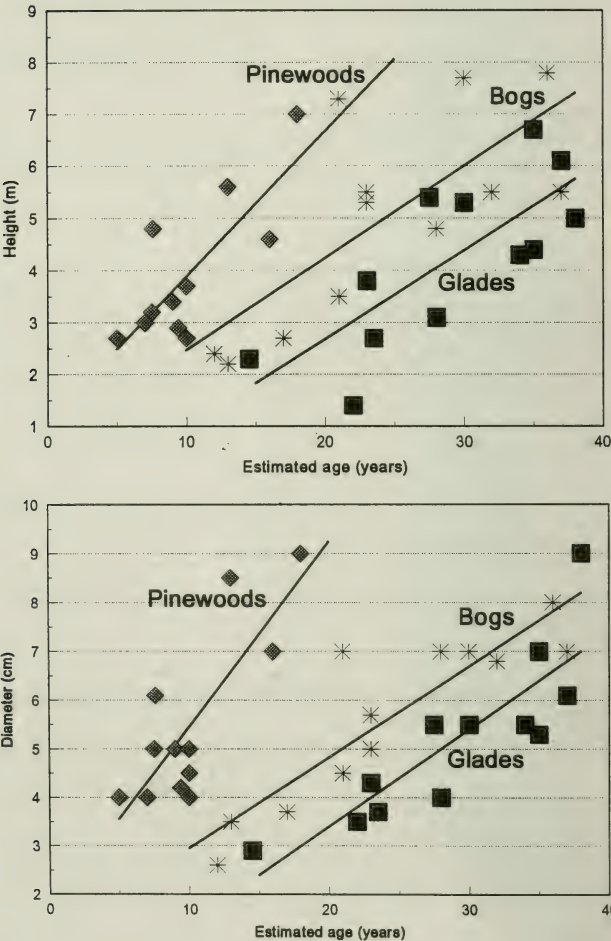


Table 5. Tree ring data for glades, bogs, and pinewoods.

Habitat	Rings per cm		
	Mean	Range	s.d.
Glades	11.5	8.5-14.0	1.6
Bogs	8.6	6.0-10.5	1.2
Pinewoods	3.7	2.5-5.0	0.8

Table 6. Number of pine seedlings found in sample plots.

Habitat	Tree Type		
	Longleaf	Other Pines	Total
Glade	30	139	169
Bog	17	12	29

(1991) cored nine relict longleaf pines in two stands in the Kisatchie Ranger District with similar results; for example, one tree with a dbh of only 23 cm was about 200 years old.

Table 6 gives the number of pine seedlings found in fifty randomly selected one meter square plots in bogs and glades. Table 7 summarizes the pine seedling survival in four permanent study plots.

DISCUSSION

We found that tree number and size in glades falls between those in bogs and pinewoods but that growth is slower than in either. While the reasons for the differences in number of trees and growth rates are not entirely clear, pyric and edaphic factors are undoubtedly important. Both bogs and glades are embedded in the fire dependent longleaf pine community and are consequently

Table 7. Pine seedling survival in four plots.

Plot	Trees Alive			
	March 1991	November 1991	November 1992	Percent Survival
Bog 1	19	17	7	37
Bog 2	19	14	7	37
Glade 1	27	10	6	22
Glade 2	26	0	0	0

subject to periodic burns (Smith 1991; Olson 1992). In presettlement times, while fires probably occurred once every two to three years, they were relatively cool and did not kill all pine seedlings. However, the edaphic conditions of bogs (highly acidic, waterlogged, nutrient poor, impermeable bedrock) and glades (seasonally desiccated, hot, nutrient poor, impermeable bedrock) (Martin *et al.* 1990) retard tree growth, making young trees extremely vulnerable to fire where herbaceous growth is extensive as, for example, in bogs dominated by *Ctenium* and other densely growing herbaceous plants (see discussion in Streng & Harcombe 1982).

In our bog plots, while pine seedlings sprouted and survived well, there was no evidence that they continued to survive beyond their first few years: slow growth makes them extremely vulnerable to fires over many years. Longleaf pines are notoriously slow growing in their early years, and although they are resistant to fire, mortality is very high when the fire is hot (Schwarz 1907; Mohr 1897; Wahlenberg 1946). Loblolly pines, while faster growing initially, are very susceptible to fire.

In glades, seedling survival was poor but better than we expected; however, this may have been the result of 1991 having been an extremely wet year with drought infrequent and of short duration. Even so, in glades, most seedlings were either scorched by the summer sun or died of desiccation during the short periods of drought. In their exposed condition they were subject not only to the direct rays of the sun but to intense ground reflection. By November, the few survivors all had brown lower needles. Certainly seed production as measured by cone production was adequate in these two habitats. Large pines in both habitats were cone producing, attested to by green cones on trees and by old cones on the ground from previous years.

In both bogs and glades, it is common to encounter trees felled by windthrow, erosion, or saturation with their shallow root systems exposed. Such mortality from falling in these two habitats is probably quite high, especially among the larger trees.

Clearly, more information on the life history of trees in these habitats would be welcome. But, as a number of workers have pointed out, instead of looking for a set of common factors, it is probably more profitable to recognize that the pattern found in open habitat of a few stunted, gnarled, slow growing trees is produced by widely differing causes. In bogs, fire is undoubtedly important in thinning the tree population since species are slow growing and therefore subject to many fires. Few escape to grow to maturity. In glades, fire is probably less important since litter accumulation is less extensive than in bogs; desiccation caused by drought and prolonged sunlight are probably more important.

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CLADIUM MARISCOIDES (CYPERACEAE) IN THE WESTERN FLORIDA PANHANDLE AND ITS PHYTOGEOGRAPHIC SIGNIFICANCE

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ABSTRACT

Cladium mariscoides (Muhl.) Torr. (Cyperaceae), recently reported as new to the flora of Florida, is discussed for the six currently known extant stations from Santa Rosa and Okaloosa counties in the western Florida panhandle. In Florida *Cladium mariscoides* occurs in areas of poorly drained, fire frequented wetland pine savannas on the outer coastal terraces of the Gulf Coastal Lowlands. It is locally abundant there on wet peaty sands of herbaceous dominated ecotonal communities above pond cypress depressions and in open canopied pond cypress swales. The associated species and phytogeographical significance of the Florida populations are discussed.

KEY WORDS: *Cladium mariscoides*, Cyperaceae, Florida, phyto-geography, disjunctions

Cladium mariscoides (Muhl.) Torr. is a perennial, rhizomatous sedge commonly found in the northeastern states and Great Lakes region, but rare in unglaciated areas (its habitat and range relationships are reviewed in Bridges & Orzell 1989, pg. 21-22). Although Florida is cited in the range of *C.*

mariscoides by several published floras, and it is included in a Florida flora checklist by Ward (1968), we have found no specific specimen citations for these reports. Bruce Hansen (pers. comm.) suggests that the Florida reports may be attributable only to a specimen by Baldwin from "St. Mary's", with no state specifically cited. This specimen may have been collected either in Florida or Georgia. Anderson (1991) reported *C. mariscoides* as new to Florida based upon a specimen collected by Burkhalter (11500, FSU, FLAS, UWFP) from Santa Rosa County, east of Gulf Breeze near Tiger Point Village subdivision, where he first discovered it on July 2, 1989. Orzell and Bridges later collected *C. mariscoides* from three other sites on the Garcon Point Peninsula in Santa Rosa County. After the senior authors informed J.R. Burkhalter of one of the Garcon Point locations, he visited the same site and made a collection. John Palis made a 1992 collection from an additional site near the Orzell and Bridges sites on Garcon Point. Steve Orzell and Richard Eilers recently added Okaloosa County to the Florida range of *C. mariscoides*. In addition to the collection sites reported below, Richard Eilers (pers. comm.) has reported observing this species at other wetland savanna sites on Eglin Air Force Base in Santa Rosa and Okaloosa counties. The collection data for our Florida specimens are as follows:

Cladium mariscoides (Muhl.) Torr. (Cyperaceae). UNITED STATES. Florida: Okaloosa Co.: Open wetland savanna surrounding a pond cypress depression pond, N of unnamed E-W road, ca. 0.3 mi E of Santa Rosa Co. line, ca. 0.5 mi S of East Bay River, ca. 1.7 air mi NW of jct paved Eglin Range Rd. 259 and US Hwy. 98 near Wynnehaven Beach; Eglin Air Force Base; NWQ, SWQ, SEQ, SWQ, Sec. 7, T2S, R25W; Navarre 7.5' USGS Quad.; 30°25'31" N, 86°47'40" W; Elev. 26 ft.; 12 Oct 1992, Orzell & R. Eilers 21086 (USF, TEX); Santa Rosa Co.: Tiger Point site: Roadside ditch and margin of low roadside through wet flatwoods, on S side of US Hwy. 98, ca. 2.2 mi E of jct Co. Rd. 191-A (Oriole Beach Rd.), ca. 4.1 mi E of E city limit of Gulf Breeze and ca. 7 air mi E of jct FL Hwy. 399 in Gulf Breeze; SEQ, SWQ, NWQ, Sec. 27, T2S, R28W; Garcon Point 7.5' USGS Quad.; 30°23'31" N, 87°02'57" W; Elev. 21 ft; 2 July 1989, J.R. Burkhalter 11480 (UWFP); 16 July 1989, J.R. Burkhalter 11500 (FLAS, FSU, UWFP); 23 June 1990, J.R. Burkhalter 11980 (UWFP); 9 July 1990, Orzell & Bridges 14299 (FTG, FSU, TEX); Garcon Point sites 1-4: (1) Burned herbaceous ecotone above pond cypress (*Taxodium ascendens* Brongn.) strand on N side of Dickerson City Rd., 0.4 mi E of FL Hwy. 191 at a point 6.7 mi SW of jct with Int. Hwy. 10, 0.6 mi N of jct FL Hwy. 281 on Garcon Point; NEQ, NEQ, NEQ, Sec. 24, T1S, R28W; Garcon Point 7.5' USGS Quad.; 30°29'04" N, 87°04'10" W; Elev. 16-19 ft; 9 July 1990, Orzell & Bridges 14297 (FLAS, FTG, GA, IBE, MO, NCU, S, SMU, TEX, VDB); 5 Aug 1990, J.R. Burkhalter 12199 (UWFP); (2) Open wetland savanna surrounding a pond cypress strand, on E side of FL Hwy. 191, ca. 0.4 mi S of jct FL Hwy. 281, on Garcon Point, ca. 4.5 mi S of jct FL Hwy. 281 and Int. Hwy. 10 at

Avalon Beach, ca. 10 mi S of Milton; SEQ, SWQ, SWQ, Sec. 24, T1S, R28W; Garcon Point USGS Quad.; 30°28'21" N, 87°04'56" W; Elev. 10 ft; 18 July 1992, Orzell & Bridges 20283 (TEX); (3) Open wetland savanna, planted in slash pine, along side road ca. 0.2 mi W of FL Hwy. 281 at a point 1.2 mi S of jct Int. Hwy. 10 at Avalon Beach, N of Trout Bayou and S of Indian Bayou; SW part of Sec. 10, T1S, R28W; Milton South 7.5' USGS Quad., 30°31'00" N, 87°05'29" W; Elev. 5-7 ft.; 31 July 1992, Bridges 20284 (TEX); (4) Open-canopied pond cypress swale in open wetland savanna, on W side of FL Hwy. 191, 6.1 mi S of jct Int. Hwy. 10, 0.7 mi S of Wilson Memorial Ch. and 1.2 mi N of jct FL Hwy. 281; SEQ, SWQ, Sec. 19, T1S, R28W; Garcon Point USGS 7.5' Quad.; 30°29'28" N, 87°04'05" W; Elev. 15-20 ft; 18 June 1992, J. Palis s.n. (USF).

Only one other species of *Cladium*, *C. jamaicense* Crantz, occurs in the southeastern United States. Since *C. mariscoides* is not treated in Godfrey & Wooten (1979) we provide a key to distinguish the two species.

1. Plants 1-3 m tall, coarse, forming dense tussocks and often in dense colonies; leaves 5-12 mm wide, stiff and flat, the margins and midrib beneath harshly serrate (saw toothed); inflorescence a narrow panicle 3-9 dm long, the flaring rays bearing several fascicles of spikelets; achene obovoid to subglobose, the truncate base not flaring.
..... *Cladium jamaicense* Crantz
1. Plants 0.4-1 m tall, relatively delicate, stoloniferous, the colonies more open; leaves 1-3 mm wide, channeled, margins only slightly scabrous; inflorescence 0.5-3 dm long, of 2-4 umbelliform cymes, the rays rigidly ascending and bearing simple glomerules of spikelets; achenes miter shaped (cylindric), the truncate bases slightly flaring.
..... *Cladium mariscoides* (Muhl.) Torr.

All of the Florida sites for *Cladium mariscoides* are on outer coastal terraces of the Gulf Coastal Lowlands physiographic region less than one mile from tidally influenced water bodies including Pensacola Bay, East Bay, Escambia Bay, Santa Rosa Sound, and the East Bay River. The Garcon Point sites lie within an extensive area of poorly drained, fire frequented, wetland pine savanna that, prior to timbering, was dominated by widely scattered *Pinus palustris* P. Mill., with abundant pitcher plants (*Sarracenia flava* L., *S. leucophylla* Raf., and *S. psittacina* Michx.), interspersed with pond cypress (*Taxodium ascendens*) dome swamps, sloughs and depressional swales. *Cladium mariscoides* occurs there on wet peaty sand (Rains soil series - Typic Paleaquults) of herbaceous dominated ecotones above *Taxodium ascendens* dominated depressions. Associated species recorded by the senior authors at the Garcon Point sites include *Amphicarpum muhlenbergianum* (Schult.) Hitchc., *Anthraenantia rufa*

(Ell.) Schult., *Aristida affinis* (Schult.) Kunth, *Aristida stricta* Michx., *Baldouina uniflora* Nutt., *Bigelovia nudata* (Michx.) DC., *Calamovilfa curtissii* (Vasey) Scribn., *Clethra alnifolia* L., *Coreopsis linifolia* Nutt., *Ctenium aromaticum* (Walt.) Wood, *Eleocharis equisetoides* (Ell.) Torr., *Eriocaulon compressum* Lam., *Eriocaulon decangulare* L., *Eupatorium leucolepis* (DC.) Torrey & Gray, *Euthamia minor* (Michx.) E. Greene, *Helianthus heterophyllus* Nutt., *Hypericum brachyphyllum* (Spach) Steud., *Hypericum cistifolium* Lam., *Hypericum myrtifolium* Lam., *Ilex glabra* (L.) A. Gray, *Ilex myrtifolia* Walt., *Juncus marginatus* Rostk., *Lachnanthes caroliniana* (Lam.) Dandy, *Lobelia floridana* Chapm., *Lophiola aurea* Ker-Gawl., *Ludwigia virgata* Michx., *Mitreola angustifolia* (Torrey & Gray) J. Nelson, *Myrica cerifera* L., *Ozypolis filiformis* (Walt.) Britt., *Panicum dichotomum* L., *Panicum scabrisculum* Ell., *Panicum virgatum* L., *Pinguicula planifolia* Chapm., *Pluchea rosea* Godfrey, *Polygala cruciata* L., *Polygala cymosa* Walt., *Polygala lutea* L., *Rhezia alifanus* Walt., *Rhezia lutea* Walt., *Rhezia virginica* L., *Rhynchospora corniculata* (Lam.) A. Gray, *Rhynchospora elliotii* A. Dietr., *Rhynchospora latifolia* (Ell.) Thomas, *Rhynchospora plumosa* Ell., *Sabatia bartramii* Wilbur, *Sabatia macrophylla* Hook., *Sarracenia leucophylla*, *Sarracenia* \times *mooreana* Veitch, *Sarracenia psittacina*, *Scleria baldwinii* (Torr.) Steud., *Smilax walteri* Pursh, *Styrax americana* Lam., *Utricularia juncea* Vahl., *Xyris serotina* Chapm., and *X. stricta* Chapm. At the Tiger Point site *Cladium mariscoides* occurs on wet peaty sand (Rutlege soil series - Typic Humaquepts) in a *Pinus elliotii* Engelm. wet flatwoods with a groundcover dominated by *Aristida stricta*, and in a roadside ditch through the wet flatwoods. The habitat, soil type, and associated species at the Eglin Air Force Base site are very similar to the above sites, but a complete list of associated species has not been compiled due to the late season collecting date. We have recorded a total of 74 vascular plant taxa growing in close association with *Cladium mariscoides* (66 taxa at the Garcon Point sites and 32 taxa at Tiger Point). The Garcon Point sites have been subjected to fairly frequent prescribed fire, whereas the Tiger Point site has been fire suppressed for a number of years and is more disturbed, thereby accounting somewhat for the differences in numbers of associates. A number of the associated species at the Florida sites (i.e., *Calamovilfa curtissii*, *Sarracenia leucophylla*, *Pinguicula planifolia*, *Xyris serotina*, *Xyris stricta*) are rare or absent outside of the East Gulf Coastal Plain.

The only other literature documented records of *Cladium mariscoides* south of North Carolina are in Horry County, South Carolina (Radford *et al.* 1968), Dooly County, Georgia (Harper 1905), Baldwin County, Alabama (Mohr 1901, Wilhelm 1984), and a questionable Tennessee record (Underwood, n.d.). Bridges & Orzell (1989) cited specimens from three Texas counties (Anderson, Henderson, and Smith). The ranges of *C. mariscoides* and *C. jamaicense* are known to overlap only on the eastern coast of the Carolinas, from Dare County in North Carolina to Horry County, South Carolina, and at the Florida and Al-

abama disjunct localities. The nearest region to Florida where *C. mariscoides* is known from several adjacent counties (i.e., is regionally frequent to the extent of being documented for most counties by general floristic collecting) is the northern part of Indiana, a distance of at least 1170 km from the region of the Florida disjunctions. Within a 1000 km radius of the western Florida panhandle sites, *C. mariscoides* is known to occur in only ten counties, three of these in Texas (Bridges & Orzell 1989), and at least two others represented by only a single collection over 80 years old. The distribution of *C. mariscoides* in the United States west of New England based on the published literature is shown in Figure 1, with its approximate northern limit in Canada indicated by a dashed line. The portion of the range eastward through New England into Quebec, New Brunswick, and southwest Newfoundland, and a western disjunct population in Saskatchewan, are not shown on Figure 1.

There is some similarity in habitat between the western Florida panhandle sites and the locations for *Cladium mariscoides* in Georgia (Harper 1905), the wetland longleaf pine savanna sites on the North Carolina coastal plain, and with some other locations on the mid-Atlantic Coastal Plain (Sipple & Klockner 1980) and the Delmarva Peninsula (Boone et al. 1984). It seems that many of the *C. mariscoides* sites in the southeastern United States are within a short distance of the current shoreline (except the Texas and North Carolina mountain sites). From North Carolina northward *C. mariscoides* commonly occurs in tidally influenced freshwater marshes or in wetlands adjacent to tidal marshes (Alan Weakley, pers. comm.; Sipple & Klockner 1980, 1984). Although the Florida sites are well above tidal influence, they could be affected by major hurricanes.

Newly discovered long distance disjunctions in the flora of the United States may have great significance in the fields of taxonomy, phytogeography, and conservation. Short disjunctions (ca. 100-300 km) can often be expected if suitable habitats for the species exists and can be located, and these kinds of disjunctions are fairly frequently reported in the southeastern United States. Disjuncts separated by moderate length (ca. 300-600 km) usually have significant differences in habitat, geologic history, and landscape ecology from the situations in the more continuous range of the species and therefore become critical in understanding phytogeographic history, patterns of speciation and floristic migration, and conservation needs for the natural communities of the region. Long disjunctions (600-1000 km) must be interpreted with caution to discern whether they represent: 1) recent adventives due primarily to human influence on the flora, 2) chance introductions by natural processes (e.g., bird or wind dispersal of seeds) which might not produce long persistent populations, or 3) longterm stable populations which may represent significant genetic variation and have speciation potential as isolated populations, and may even be relicts of a once more continuous range now isolated by climatic changes.

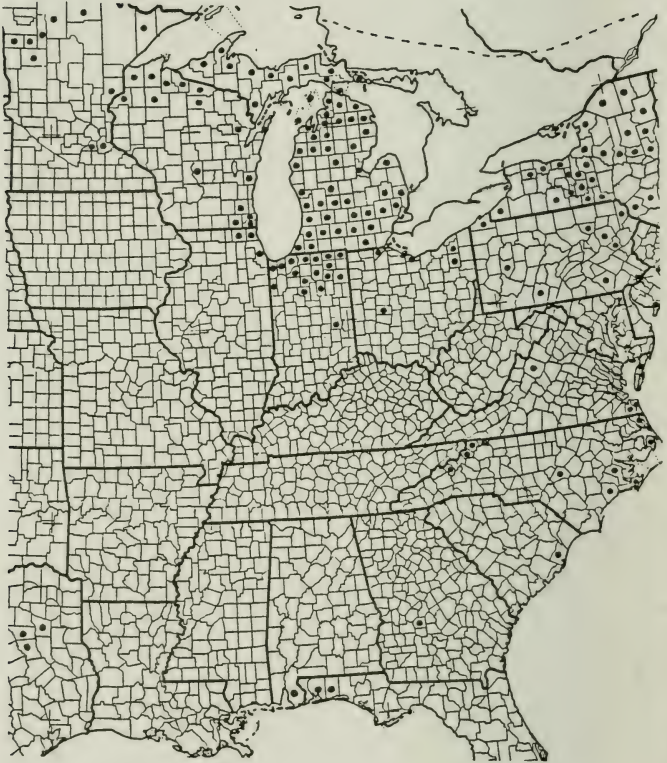


Figure 1: County distribution map for *Cladium mariscoides* in the United States. The approximate range limit in Canada is indicated by a dashed line. The portion of the range eastward through New Jersey, New York, and New England into Quebec, New Brunswick, and southwest Newfoundland, the northern limit in Minnesota and Ontario, and a western disjunct population in Saskatchewan are not shown on the map.

Based on its abundance and relative dominance in little disturbed communities at its southeastern United States locations, we interpret *Cladium mariscoides* as probably relictual in this region. This interpretation is strengthened by the uniqueness of its habitat at the Texas deep muck bog sites (Bridges & Orzell 1989) and North Carolina mountain fens (Schafale & Weakley 1990). These unique habitats are rarely replicated in the region. However, the habitats of the southeastern coastal plain sites are apparently duplicated at hundreds of sites lacking *C. mariscoides* in the intervening area. The rarity of *C. mariscoides* in the coastal plain of Alabama, Florida, Georgia, South Carolina, and North Carolina is as yet difficult to correlate with scarcity or uniqueness of physical habitat parameters. However, there may be some not yet understood correlations with disturbance factors and fire history. All of the Garcon Point sites are frequently burned and *C. mariscoides* responds well to low intensity ground fires, without which in the southeastern coastal plain it may be shaded out by wetland broadleaf evergreen shrubs and trees. Further study will be needed in order to adequately explain the existence of this northern species at the disjunct sites near the Gulf of Mexico.

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NOMENCLATURAL NOTES FOR THE NORTH AMERICAN FLORA. XII.

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ABSTRACT

Turner's usage of the name *Ruellia nudiflora* var. *runyonii* is justified. *Aira elegans*, *Tetragonia tetragonoides*, and *Tradescantia spathacea* are accepted to replace *A. elegantissima*, *Tetragonia expansa*, and *Tradescantia discolor*, respectively. The authorship of *Anthraenantia rufa*, *Arundinaria gigantea*, *Coridochloa cimicina*, *Deschampsia danthonioides*, *D. elongata*, *Digitaria ischaemum*, *Orthocarpus imbricatus*, *O. purpureoalbus*, *Sclerochloa californica*, *Townsendia condensata*, and *Vulpia microstachya* is addressed. Typification of *Atriplex canescens*, *Erechtites*, *Menodora longiflora*, *M. scabra*, and *Uraspermum barbatum* is discussed.

KEY WORDS: Acanthaceae, Aizoaceae, Apiaceae, Asteraceae, Chenopodiaceae, Commelinaceae, Oleaceae, Poaceae, Scrophulariaceae, *Aira*, *Anthraenantia*, *Arundinaria*, *Atriplex*, *Coridochloa*, *Deschampsia*, *Digitaria*, *Erechtites*, *Menodora*, *Orthocarpus*, *Ruellia*, *Sclerochloa*, *Tetragonia*, *Townsendia*, *Tradescantia*, *Uraspermum*, *Vulpia*.

INTRODUCTION

Continuing with the "NOMENCLATURAL NOTES FOR THE NORTH AMERICAN FLORA" (Kartesz & Gandhi 1989, 1990a, 1990b, 1990c, 1991a, 1991b, 1991c, 1991d, 1992a, 1992b, 1992c), a twelfth note in the series is presented here toward advancing our understanding of North American plant names.

ACANTHACEAE

Ruellia nudiflora var. *runyonii*

Turner (1991, p. 291) treated *Ruellia runyonii* Tharp & Barkley at varietal rank making the combination *R. nudiflora* var. *runyonii* (Tharp & Barkley) B. Turner. He further cited *R. runyonii* var. *berlandieri* Tharp & Barkley as a synonym of var. *runyonii*. Some workers may believe that Turner erred in choosing the epithet *runyonii* over the epithet *berlandieri*, since the latter existed as a varietal name, and since a name has priority within its own rank (*International Code of Botanical Nomenclature* [ICBN] Art. 60.1). However, we assert that Turner was correct in his treatment and that any nomenclatural confusion may be attributed to the absence of a discussion and to the incomplete basionym citation by Turner. Our discussion is provided here.

When Tharp & Barkley (Amer. Midl. Naturalist 42:56. 1949) proposed *Ruellia runyonii* var. *berlandieri*, they automatically created *R. runyonii* var. *runyonii* (ICBN Art. 26.2). If these two varieties represent a single taxon, then the autonym (i.e., var. *runyonii*) has priority over var. *berlandieri* (ICBN Art. 57.3).

Ruellia nudiflora (Engelm. & Gray) Urban var. *runyonii* (Tharp & Barkley) B. Turner, *Phytologia* 71:291. 1991. BASIONYM: *Ruellia runyonii* Tharp & Barkley (Amer. Midl. Naturalist 42:56. 1949.) var. *runyonii* (automatically created by *Ruellia runyonii* Tharp & Barkley var. *berlandieri* Tharp & Barkley).

Ruellia runyonii Tharp & Barkley var. *berlandieri* Tharp & Barkley, Amer. Midl. Naturalist 42:56. 1949

AIZOACEAE

Tetragonia tetragonioides

The New Zealand Spinach, a native of Asia and Australia, has become naturalized throughout the United States: CA, CT, FL, HI, MA, NC, ND, NY, PA, WV, to Caribbean (Kartesz, unpublished). Many workers, such as Small (1933, p. 493), Adamson (J. S. African Bot. 21:147. 1955.), Munz (1959, p. 308), Ahles (in Radford *et al.* 1968, p. 431), and Bogle (J. Arnold Arbor. 51:460. 1970.) have used the name *Tetragonia expansa* Murr. (published in 1783) for this species. Of these authors, Bogle alone mentioned *T. tetragonioides* (Pall.) O. Kuntze (based on *Demidovia tetragonioides* Pall., published in 1781) as a synonym, but provided no discussion for using a later name and citing an earlier one in synonymy. Wunderlin (1982, p. 179), Jessop (1986, p. 205), Pienaar (in Gibbs Russell *et al.* 1987, p. 25), recognized the name *T.*

tetragonoides and cited *T. expansa* as a synonym. Although we corresponded with Bogle regarding his usage of the name *T. expansa*, he had no additional information. With the information available, we recognize *T. tetragonoides* to be the correct name for this species.

Tetragonia tetragonoides (Pall.) O. Kuntze, *Revis. Gen. Pl.* 2:269. 1891.
BASIONYM: *Demidovia tetragonoides* Pall., *Enum. Hort. Demidof.* 150, t. 1. 1781.

Tetragonia expansa Murr., *Commentat. Soc. Regiae Sci. Gott.* 6:13, t. 5. 1783.

APIACEAE

Typification of *Uraspermum barbatum*

Lowry & Jones (*Ann. Missouri Bot. Gard.* 71:1162. 1984.) stated that McVaugh *et al.* (*Bull. Cranebrook Inst. Sci.* 34:79. 1953.) lectotypified the name *Uraspermum barbatum* Farwell by *Farwell 8490* (BLH). They considered the duplicate collection on deposit at GH as the isoelectotype.

Farwell (*Amer. Midl. Naturalist* 12:70. 1930.), in the protologue of *Uraspermum barbatum*, cited "Rocky woods, Copper Harbor, No. 8490, Jul 24, 1929." Since Farwell cited a single collection, no syntypes are involved and thus, lectotypification is unnecessary. The collection at BLH must be designated as the holotype, and duplicates of this collection found elsewhere must be designated as isotypes. McVaugh *et al.* (p. 10) asserted a similar opinion: "When he (Farwell) cited no more than one number or collection with the description of a new entity, we have taken the cited specimen as the type ... When Farwell cited more than one number with the description, a lectotype must be designated ... " We conclude that McVaugh *et al.* did not designate a lectotype and that Lowry & Jones misinterpreted McVaugh *et al.*'s treatment. McVaugh (NCU; pers. comm.) concurred with our analysis.

Uraspermum barbatum Farwell, *Amer. Midl. Naturalist* 12:70. 1930. HOLOTYPE: UNITED STATES. Michigan: Keweenaw Co., 24 Jul 1929, *Farwell 8490* (BLH).

ASTERACEAE

Erechtites

Rafinesque (1817) published *Erechtites* as a monotypic genus with *E. praealta* Raf. as its species. Therefore, *E. praealta* must be cited as the type species of this genus, which Belcher (Ann. Missouri Bot. Gard. 43:10. 1956.) and Farr *et al.* [*Index Nominum Genericorum (Plantarum)* 2:631. 1979.] correctly did. However, Barkley & Cronquist (*N. Amer. Fl.* II. 140. 1978.) cited *E. hieraciifolia* (L.) Raf. *ex* DC. as the type, which amounted to a neotypification. Although *E. praealta* is presently treated as a taxonomic synonym of *E. hieraciifolia*, the former name stands as the type species of *Erechtites*.

Erechtites Raf., *Fl. Ludov.* 65. 1817. TYPE: *Erechtites praealta* Raf.

Townsendia condensata

Parry (Amer. Naturalist 8:106. 1874.) proposed *Townsendia condensata* as a provisional name (*nom. invalid.*; *ICBN* Art. 34.1a). Later, Eaton (Amer. Naturalist 8:213. 1874.) used the name *T. condensata* and provided a description. Subsequent workers, such as Beaman (1957, p. 118), accepted Eaton as the author of this species. Our analysis follows.

Although it appears that Eaton validated this name, his protologue indicates otherwise: "Not having seen a specimen of Nuttall's *T. incana*, I have some doubt as to whether this may not be his plant of that name. If not, it may properly bear the name which Dr. Parry has proposed." It is evident from Eaton's remarks that he did not definitely accept this name; therefore, this name was not validated in Eaton's treatment (*ICBN* Art. 34.1a, b). To the best of our knowledge, Gray was the first to validate the name *Townsendia condensata*, and he ascribed the name to Parry; therefore, the correct author citation of this species is: Parry *ex* A. Gray.

Townsendia condensata Parry *ex* A. Gray, *Syn. Fl. N. Amer.* 1(2):167. 1884.

CHENOPODIACEAE

Atriplex canescens var. *canescens*

According to Stutz (1978), the type specimen of *Atriplex canescens* (Pursh) Nutt. (a Lewis collection from South Dakota) is referable to the low subherbaceous expressions of this species, which have been known as *A. canescens* ssp. *aptera* (A. Nelson) Hall & Clements. This assertion by Stutz is contrary to the

established usage of the name *A. canescens*, which pertains to the tall shrubby expressions of this species throughout the west. If Stutz's conclusion is correct, then the tall shrubby expression of this complex requires a new name, either at specific or infraspecific rank. However, McNeill *et al.* (1983, p. 553) rejected the Stutz analysis. These authors indicated that the Lewis collection was a mixture of both the low and the tall expressions of this complex. With this finding, McNeill *et al.* lectotypified the name *A. canescens* with that portion of the mixed collection assignable to the tall expression, and thus maintained its traditional usage.

Without referencing McNeill *et al.* (*l.c.*), Welsh & Stutz (*in* Welsh 1984, p. 188) accepted Stutz's typification and proposed a new combination [*Atriplex canescens* var. *occidentalis* (Torr. & Frem.) Welsh & Stutz] to include the tall expression of *A. canescens*, found in Utah. Their new combination is based on the type of *Pterochiton occidentale* Torr. & Frem. collected from the Great Salt Lake. Welsh (*in* Welsh *et al.* 1987, p. 118) continued to recognize the name *A. canescens* var. *occidentalis*. However, Dorn (1988, p. 303) remarked that Welsh's use of the preceding name "appears inappropriate in light of selection of a lectotype by McNeill *et al.* (Taxon 32:553, 1983)."

We accept McNeill's lectotypification, and thus recognize var. *occidentalis* as a taxonomic synonym of *Atriplex canescens* var. *canescens*, since the type of the typical expression of *A. canescens* includes the type of var. *occidentalis*.

Atriplex canescens (Pursh) Nutt., *Gen. N. Amer. Pl.* 1:197. 1817. *Atriplex canescens* (Pursh) Nutt. var. *canescens*. BASIONYM: *Calligonum canescens* Pursh, *Fl. Amer. Sept.* 2:370. 1814. LECTOTYPE (*vide* McNeill *et al.* Taxon 32:553. 1983.): UNITED STATES. South Dakota: Big bend of Missouri, 21 Sep 1804, Lewis *s.n.*, right hand shoot of the specimen (PH).

Pterochiton occidentale Torr. & Frem. *in* Frem., *Rep. Exped. Rocky Mts.* 318. 1845. *Atriplex canescens* (Pursh) Nutt. var. *occidentalis* (Torr. & Frem.) Welsh & Stutz, *Great Basin Naturalist* 44:188. 1984.

COMMELINACEAE

Tradescantia spathacea

The boat-lily, a widespread tropical weed of the New World, has long been known as either *Tradescantia spathacea* Sw. or *T. discolor* L'Her. Stearn (Baileya 5:195-198. 1957.) indicated that the name *T. discolor* (published in Dec 1788-Jan 1789) has priority over the competing name *T. spathacea* (published in Jun-Jul 1788). He transferred *T. spathacea* to the genus *Rhoeo* and made

the combination: *Rhoeo spathacea* (Sw.) Stearn. However, we maintain the boat-lily within *Tradescantia*.

Later, Tucker (J. Arnold Arbor. 70:111. 1989.) recognized the name *Tradescantia discolor* for the boat-lily and cited *T. spathacea* and *R. spathacea* as synonyms. He also erred in attributing *R. spathacea* to: (Sw.) Hance.

Tradescantia spathacea Sw., Prodr. 57. Jun-Jul 1788. *Rhoeo spathacea* (Sw.) Stearn, Bailey 5:198. 1957.

Tradescantia discolor L'Her., Sert. Angl. 8, t. 12. Jan 1789.

OLEACEAE

Menodora longiflora and *M. scabra*

Steyermark (1932) attributed the names *Menodora longiflora* (pp. 143-147) and *M. scabra* (pp. 134-137) to "(Engelm.) Gray," and cited "*Lindheimer 652*" and "*Wislizenus 68*," respectively as the types. Turner (1991a, pp. 347, 352) attributed both names to "Engelm. ex A. Gray." Regarding typification, Turner recognized the Wislizenus specimen as the "holotype" for *M. scabra*, but designated Lindheimer's collection as the lectotype for *M. longiflora*. Our analysis on the authorship and the typification of these two names follows.

The authorship of the names *Menodora longiflora* and *M. scabra* must not be cited as "Engelm. ex Gray", since Gray (Amer. J. Sci. II. 14:44-45. 1852.) did not ascribe them to Engelmann. Although Gray cited the reference "*Bolivar longiflora* Engelm. Mss." for *M. longiflora* and the reference "*Bolivar scabra* Engelm. Mss." for *M. scabra*, these two unpublished names of Engelmann do not qualify as basionyms; therefore, the authorship must not be cited as "(Engelm.) Gray." We conclude that Gray alone is the author of both *M. longiflora* and *M. scabra*. Their typification is discussed below.

In the protologue of *Menodora longiflora*, Gray referenced "Texas, Lindheimer (no. 652, & C.), Wright (No. 564)." Since Gray cited two collections, this name needed lectotypification, which Steyermark (1932, p. 146) did by Lindheimer's specimen. Although Steyermark referenced both collections, he designated Lindheimer's specimen as the type, but did not state the reasons for his preference of Lindheimer's specimen over Wright's specimen. Nevertheless, Steyermark's typification must be construed as lectotypification. Therefore, Turner's lectotypification of this name by Lindheimer's specimen is irrelevant.

Regarding *Menodora scabra*, Gray referenced the following: New Mexico, Wislizenus, Fendler (no. 699), Wright (No. 563). Saltillo, México, Gregg (No. 527). Since Gray cited three collections from New Mexico and one collection from México, the name needed lectotypification. Of these four collections, Steyermark (1932, p. 136) referenced Wislizenus' and Fendler's collections,

but did not comment on Wright's and Gregg's collections. As noted above, Steyermark's typification of this name by Wislizenus' specimen must be construed as lectotypification. For this reason, Turner's designation of Wislizenus' specimen as the holotype must be corrected as the lectotype chosen by Steyermark.

Menodora longiflora A. Gray, Amer. J. Sci. II. 14:45. 1852. LECTOTYPE (vide Steyermark, Ann. Missouri Bot. Gard. 19:146. 1932.): UNITED STATES. Texas: Upper Guadalupe, Jun 1847, Lindheimer 652 (MO).

Menodora scabra A. Gray, Amer. J. Sci. II. 14:44. 1852. LECTOTYPE (vide Steyermark, Ann. Missouri Bot. Gard. 19:136. 1932.): UNITED STATES. New Mexico: Ojo del Muerto, south of Santa Fe, 2 Aug 1846, Wislizenus 68 (MO).

POACEAE

Aira

We (Phytologia 69:301-302. 1990.) stated that the name *Aira elegans* Willd. ex Gaudin was not validly published in Gaudin's work (*Agrost. Helv.* 1:130. 1881.). Therefore, we followed Tutin (*Fl. Europaea* 5:227. 1980.) in accepting the name *A. elegantissima* Schur (published in 1853). Later, we found that Kunth (1833, p. 289) used the name *A. elegans* and validated it. Since *A. elegans* has priority from 1833, it is indeed the correct name for this species.

Aira elegans Willd. ex Kunth, Enum. Pl. 1:289. 1833.

Aira elegantissima Schur, Verh. Mitth. Siebenburg. Vereins Naturwiss. Hermannstadt 4(*Sert. Fl. Transs.*):85. 1853.

Anthraenantia rufa, *Aulazanthus rufus*, *Aulaxia rufa*

The name *Aulazanthus rufus* has been generally credited to Elliott (Hitchcock & Chase 1951, p. 818; Gould 1975, p. 420). Our analysis follows.

In the protologue of *Aulazanthus rufus*, Elliott (1816, p. 103) remarked: "It may be merely a variety produced by a difference of soil ... I insert it here for future observation." Elliott's remarks explicitly indicate that he did not definitely accept this name and that he proposed it as a provisional name. Since Elliott did not meet the requirements of valid publication of *Aulazanthus rufus* (Art. 34.1a, b), he must not be cited as a parenthetical author for later

combinations based on his type (Art. 45.3). Nuttall (1818, p. 47) transferred Elliott's name to *Aulazia* Nutt. making the combination *Aulazia rufa*, for which Nuttall alone is the author (i.e., no parenthetical authorship involved). For all subsequent combinations based on Elliott's type, Nuttall must be cited as the parenthetical author. Presently, we are recognizing this taxon in the genus *Anthraenantia* P. Beauv.

Anthraenantia rufa (Nutt.) Schultes, *Mant.* 2:258. 1824. BASIONYM:
Aulazia rufa Nutt., *Gen. N. Amer. Pl.* 1:47. 1818. *Aulazanthus rufus* Ell., *Sketch Bot. S. Carolina* 1:103. 1816, *nom. pro.* (*nom. invalid.*).

Arundinaria gigantea

Walter (1788, p. 81) described the cane grass in Carolina as *Arundo gigantea*. Without referencing Walter, Michaux (1803, p. 74) described the same grass as *Arundinaria macrosperma*; therefore, the types for Walter's name and Michaux's name are different. In his 1813 *Catalogue*, Muhlenberg (p. 14) ascribed the name *Arundinaria gigantea* to Walter. Muhlenberg's reference to Walter must be construed as an indirect reference to the basionym *Arundo gigantea* Walt.; therefore, the combination *Arundinaria gigantea* (Walt.) Muhl. was validly made (ICBN Art. 33.2). Elliott (1816, p. 96), without referencing Muhlenberg, recognized the name *Arundinaria macrosperma* and cited *Arundo gigantea* as its synonym.

The status of the name *Arundinaria gigantea* in Chapman (1860, p. 561) is a complicated issue. He did not mention its authorship. Furthermore, he referenced *Arundinaria macrosperma*, but made no reference to Walter, Muhlenberg, or Elliott. It is most likely that Chapman was aware of Muhlenberg's name and used it. But, in the absence of a direct or indirect reference to Walter, Muhlenberg, or Elliott, Chapman's usage should be construed as a *nom. nov.* for *A. macrosperma*, and the type for *A. gigantea* Chapm. must be the same as that of *A. macrosperma*. In other words, *A. gigantea* Chapm. is a later homonym of *A. gigantea* (Walt.) Muhl., rather than an isonym.

Arundinaria gigantea (Walt.) Muhl., *Cat. Pl. Amer. Sept.* 14. 1813. BASIONYM: *Arundo gigantea* Walt., *Fl. Car.* 81. 1788.

Arundinaria macrosperma Michx., *Fl. Bor.-Amer.* 1:74. 1803.

Arundinaria gigantea Chapm., *Fl. S. U.S.* 561. 1860, *non* (Walt.) Muhl.

Coridochloa

The combining authorship of *Coridochloa ciminica* has often been attributed to Nees ex Jacks. (Hitchcock & Chase 1951, p. 847). Our analysis follows.

Jackson cited this name as a synonym of *Panicum ciminum*; therefore, he did not validate the combination. To the best of our knowledge, Chase was the first to validate the combination.

Coridochloa ciminica (L.) Nees [ex Jacks., *Ind. Kew.* 1:618. 1893, *pro. syn.*] ex Chase, *Proc. Biol. Soc. Wash.* 24:129. 1911.

Deschampsia, *Vulpia*, *Sclerochloa*

Hitchcock & Chase (1951, pp. 293, 853, 874) and Holmgren (*in* Cronquist *et al.* 1977, pp. 204, 260, 262) cited the combining authorship of *Deschampsia danthonioides*, *D. elongata*, and *Vulpia microstachya* as Munro ex Benth. On p. 341, Bentham (1857, p. 341, footnote) stated that the taxonomy of grasses was determined by Munro; therefore, the four novelties proposed in the grass section of this work must be credited to Munro alone.

Deschampsia danthonioides (Trin.) Munro *in* Benth., *Pl. Hartw.* 342. 1857.

Deschampsia elongata (Hook.) Munro *in* Benth., *Pl. Hartw.* 342. 1857.

Sclerochloa californica Munro *in* Benth., *Pl. Hartw.* 342. 1857, *nom. nud.*

Vulpia microstachya (Nutt.) Munro *in* Benth., *Pl. Hartw.* 342. 1857.

Digitaria

Hitchcock & Chase (1951, p. 854), Gould (1975, p. 411), and Holmgren (*in* Cronquist *et al.* 1977, p. 365) cited the combining authorship of *Digitaria ischaemum* as Schreb. ex Muhl. Regarding its valid publication, Gould cited Muhlenberg's 1813 work, whereas Hitchcock & Chase, and Holmgren cited Muhlenberg's 1817 work. Our analysis follows.

For his combination *Digitaria ischaemum*, Muhlenberg (1813) neither provided a description nor referenced its basionym details (*Panicum ischaemum* Schreb.). Since he failed to cite even the author of the basionym, he clearly did not meet the requirements of ICBN Art. 32.4 for indirect reference. Therefore, this combination was not validly made in this work. Later, Muhlenberg (1817) described this grass and cited Schreber, but failed to include the basionym. Based on ICBN Art. 32 Ex. 5, Muhlenberg's citation of Schreber must be construed as an indirect reference to *P. ischaemum*; hence, Muhlenberg alone is the combining author of *D. ischaemum*. The correct author citation is given below.

Digitaria ischaemum (Schreb.) Muhl., *Descr. Gram.* 131. 1817.

SCROPHULARIACEAE

Authorship of *Orthocarpus imbricatus* and *O. purpureoalbus*

Chuang & Heckard (1992, pp. 567, 579) attributed the name *Orthocarpus purpureoalbus* to A. Gray in S. Watson and *O. imbricatus* to Torrey in S. Watson. These two names were published in the appendix portion (pp. 429-497) of the 5th volume of *United States Geological Exploration* (sic) *of the Fortieth Parallel* by C. King (also called *Botany* [fortieth parallel] or *Bot. King Exped.*) published in 1871. Although the botany section included contributions from Eaton, Engelmann, Gray, James, Olney, Robbins, Torrey, and Tuckerman, the text was chiefly written and authored by S. Watson. The contribution of each author is indicated on the appropriate page. Since no author was listed for the appendix, S. Watson was responsible for its contents. Although he ascribed the name *O. purpureoalbus* to Gray and *O. imbricatus* to Torrey, and cited their herbarium manuscript, he did not definitely indicate that the validating description of these two taxa were from Gray or Torrey. Therefore, S. Watson must be credited for the valid publication of these two names, as given below.

Orthocarpus imbricatus Torr. ex S. Wats., *Botany* [fortieth parallel] 458. 1871.

Orthocarpus purpureoalbus A. Gray ex S. Wats., *Botany* [fortieth parallel] 458. 1871.

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BOOKS RECEIVED

Annual Review of Ecology and Systematics, Volume 23. Daphne Gail Fautin, Douglas J. Futuyma, & Frances C. James (eds.). Annual Reviews, Inc., 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94306-0897. 1992. xii. 556 pp. \$44.00 (cloth-United States); \$49.00 (cloth-elsewhere). ISBN 0-8243-1423-9. ISSN 0066-4162.

Nearly the first half of this volume is devoted to effects of global environmental change on ecology and systematics. This treatment includes geographic, geologic, and social issues as well as effects of global environmental change on organisms. Other topics considered in this volume include hybridization as an evolutionary process, nearly neutral theory of molecular evolution, artificial selection experimentation, gastropod phylogeny, trace fossils, behavioral homology, a comparison of comparative methods, use of readily available statistical tests, an assessment of phylogenetic taxonomy, population viability analysis, and evaluation of behavioral and developmental fitness.

Annual Review of Entomology, Volume 38. Thomas E. Mittler, Frank J. Radovsky, & Vincent H. Resh (eds.). Annual Reviews, Inc., 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94306-0897. 1993. x. 459 pp. \$44.00 (cloth-United States); \$49.00 (cloth-elsewhere). ISBN 0-8243-0138-2. ISSN 0066-4170.

Topics considered in this volume include genetic mapping in insects, diversity/systematics of various insect taxa, insect mimicry, genetic manipulations of insects, insect endocrinology, fossilized insects, physiological studies, use of geographic information systems for insect ecology, and a host of others. The eighteen papers in this volume were written by 31 authors. The book includes a subject index, and cumulative indices to authors and titles for the previous ten volumes.

Annual Review of Phytopathology, Volume 30. R. James Cook, George A. Zentmyer, & Gregory Shaner (eds.). Annual Reviews, Inc., 4139 El Camino Way, P.O. Box 10139, Palo Alto, California 94306-0897. 1992. xii. 692 pp. \$46.00 (cloth-United States); \$51.00 (cloth-elsewhere). ISBN 0-8243-1330-5. ISSN 0066-4286.

Volume 30 in this series covers biotechnological perspectives of plant pathology, biographical summaries of three "pioneers" of plant pathology, nomenclature and taxonomy in plant pathology, pathogens (fungal, bacterial, viral, and nematodes), interactions between hosts and pathogens, abiotic stress, molecular genetics, breeding for resistance, and control of pathogens. Twentynine papers were contributed by 57 authors.

Biology of Plants, Fifth Edition. Peter H. Raven, Ray F. Evert, & Susan E. Eichhorn. Worth Publishers, 33 Irving Place, New York, New York 10003. 1992. xx. 791 pp. \$59.95 (hardcover). ISBN 0-87901-532-2.

This fifth edition of a widely used university text has been considerably revised. Most notable are an enlarged treatment of ferns, altered views on early evolution of angiosperms, treatments of current (for a textbook) ecological/environmental issues (Yellowstone fire, old growth logging), and recognition of three divisions of bryophytes. Supplements to the text (not seen) include a laboratory manual, computer simulation, an instructor's guide, test bank, test generation system, and transparencies.

The Concise Oxford Dictionary of Botany. Michael Allaby (ed.). An Oxford Paperback Reference, Oxford University Press, 200 Madison Avenue, New York, New York 10016. 1992. vi. 442 pp. \$11.95 (paper). ISBN 0-19-286094-1.

This book is not a dictionary in the strictest sense, since many of the terms included are accompanied by considerable information beyond a simple definition. In addition to terms that might be expected in such a work, plant families and many genera are included. These entries typically consist of a brief morphological description, notation of economic importance, and information on size and geographic distribution of the taxon. It is not clear what criteria were used to select the taxonomic entries since they are far from exhaustive.

Ethylene in Plant Biology, Second Edition. Frederick B. Abeles, Page W. Morgan, & Mikal E. Saltveit, Jr. Academic Press, Inc., 1250 Sixth Avenue, San Diego, California 92101-4311. 1992. xvi. 414 pp. \$65.00 (hardcover). ISBN 0-12-04145101.

Updating the 1973 edition, this book provides current information on the role of ethylene in plant growth and metabolism. The book contains information on properties of ethylene itself, followed by chapters on various aspects of effects of ethylene on plants. These discussions include synthesis of ethylene, regulation of synthesis, effects on dormancy, growth, development, ripening, and abscission. Mechanisms of ethylene action are considered, as well as effects on the environment of plant production of ethylene. The final chapter considers agricultural use of ethylene.

Fruit and Seed Production, Aspects of Development, Environmental Physiology and Ecology. C. Marshall & J. Grace (eds.). Society for Experimental Biology Seminar Series 47. Cambridge University Press, 40 West 20th Street, New York, New York 10011-4211. 1992. xii. 256 pp. \$79.95 (hardcover). ISBN 0-521-37350-6 (hardcover).

Produced as a result of the 1990 meeting of the Environmental Physiology Group of the Society for Experimental Biology, twelve authors have contributed eleven papers toward this volume. Topics range from an overview of reproductive biology to internal regulation of fruiting in Cox's Orange Pippin apple. Additional topics treated are pollination/fertilization, embryogenesis, fruit growth, regulation of maternal investment in reproduction, allocation of reproductive resources, effects of seed set on geographic distributions, and seed dispersal.

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